Spectrum Analyzer

User Manual

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Spectrum Analyzer

This document is intended to provide guidance and instruction on using the OSCOR Green Spectrum Analyzer for detecting electronic surveillance devices.

The overall effectiveness of this product, and of any surveillance countermeasure, is dependent on the threat level and the user's ability to properly utilize the appropriate equipment.

Revision 1.2.0.8

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This manual contains proprietary information intended solely for use with the OSCOR Green Spectrum Analyzer.

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U.S. PATENTS: 6,397,154; 7,058,530
Additional Patents Pending

NOTE: The overall effectiveness of any technical surveillance countermeasure is directly dependent on the level of threat and the user's ability to properly utilize the appropriate equipment. REI's Center for Technical Security offers training on technical surveillance countermeasure equipment.

OWNER'S RECORD
The Serial Number of each OSCOR Green is located on the back of the unit. Please record this number and refer to it whenever you contact your dealer or Research Electronics International concerning this product. Note: Removal or alteration of the serial number automatically voids all warranties of this product.

SERIAL NUMBER: _____

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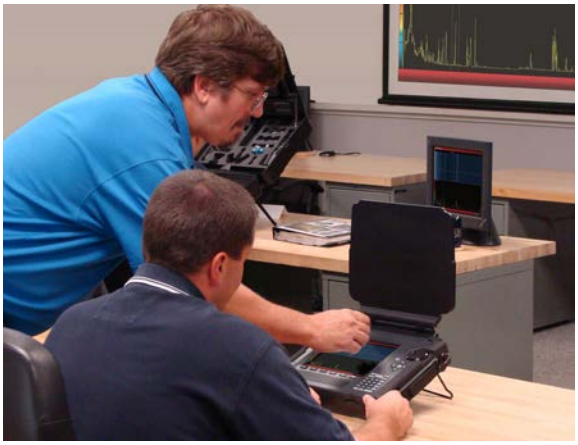
TSCM Training

REI Center for Technical Security: REI offers the world's largest commercially available Technical Surveillance Countermeasure (TSCM) training facility. Training courses include classroom instruction and hands-on exercises where students perform sweep exercises in "live" environments utilizing "target rich" project rooms. The progressive course curriculum is designed for the beginner or the seasoned TSCM Technician.

Regularly scheduled courses are taught monthly; visit REI's website (www.reiusa.net) or contact REI (sales@reiusa.net) for training dates.



Contact REI for more information about TSCM training and/or other TSCM equipment: www.reiusa.net

PRECAUTIONS

- **Maximum Input Voltages and Power**
  - **8 GHz – 24 GHz Antenna Input** (see page 4): 0 VDC, +20 dBm
    Caution: To avoid damage to the OSCOR unit do not apply any DC voltage to this input
  - **0 – 8 GHz Antenna Input** (see page 4): ≤ 5 VDC, +20 dBm
  - **Aux RF Input** (see page 5): ≤ 5 VDC, +20 dBm
- The Antenna Panel Control connector (see page 4), which is the 6 pin modular plug marked "CTRL" on the back of the unit, is used for power to and communication with the antenna panel. To avoid damage to the unit and internal circuitry, do not use this connector for telephone connections.
- Only use REI approved power sources, batteries, chargers, and probes.
- **CAUTION** The antenna panel can be damaged by a high-level electrostatic discharge (ESD) to the whip antenna connector. In an area where static discharges are likely, such as in dry conditions, or on carpeting, avoid contact with this connector located on the top of the antenna panel.

- **CAUTION** High-level electrostatic discharges (ESD) to the USB-A, USB-B, and Ethernet connectors could result in possible damage or mis-operation of the OSCOR unit. Observe industry standard precautions for handling static sensitive equipment.
- Provide adequate ventilation around the cooling fan inlet and outlet of the OSCOR unit. These are located on the underside of the input panel located at the rear of the unit.
- There are no serviceable parts inside. Contact your dealer or Research Electronics International, LLC for repairs. Opening the unit will void the warranty.
- Exercise care in walking or other movements while operating the OSCOR unit. Serious injuries may result.

EQUIPMENT DESCRIPTION

Main Panel

1. **POWER** – turns the unit off and on. Press and hold the power button until the unit shuts off to do a firmware reset. As the unit powers on, the power button will display various patterns of solid and blinking colors to indicate successful initialization and self-test. This is a list of the various colors the power button will display during operation and what each color indicates:

   <u>Power Button Indications</u>
   With the Unit On:

   Solid Blue – Operating on Battery with no AC connected
   Solid White – Battery is charging
   Solid Green – Battery fully charged
   Solid Yellow – No battery detected
   Decaying Yellow – Low battery

Decaying Red – Low battery, shutdown is imminent
Blinking Red – Battery Fault (disconnect power and remove battery)

With the Unit Off but with AC Power Connected:

Pulsing White – Battery is charging
Blinking Yellow – No battery detected
Blinking Green – Battery is fully charged

2. **HELP** – launches on-screen help file. Also used as part of the key sequence for capturing screen shots (see page 21)
3. **MUTE** – mutes the speakers
4. **VOLUME** – increases/decreases volume level
5. **F-KEYS** – multi-use function keys. Functions corresponding to each F-key will be labeled on the display screen and will change depending on the current mode or sub-menu.
6. **ROTARY DIAL** – allows precise frequency selection of whichever parameter is currently selected (START, STOP, CENTER, SPAN, or CURSOR). Also provides ability to adjust various control parameters.
7. **TAB** – used to navigate between fields (such as within signal lists or dialog screens)
8. **UP/DOWN/LEFT/RIGHT** (arrow keys) – function varies depending on context. In sweep mode, if you are only displaying part of the spectrum, the left and right keys move up and down through the spectrum.
9. **OK** – used for confirming selections and displaying context-sensitive menus
10. **SWEEP/ANALYZE** – allows instant jump between receiver's spectrum graphic display and demodulated signal analysis
11. **EXPAND/MAX** – Expands the displayed frequency span. When the SHIFT key is pressed immediately before this key, the frequency span is expanded to the max frequency span of 24.025 GHz.
12. **NARROW/MIN** – Narrows the displayed frequency span. When the SHIFT key is pressed immediately before this key, the frequency span is changed to the narrowest frequency span of 1.22 MHz.

13. **CENTER/START** – Highlights the CENTER field, to allow changes to the frequency of the CENTER of the displayed span. When the SHIFT key is pressed immediately before this key, the START field is highlighted, allowing changes to the displayed START frequency.

14. **SPAN/STOP** – Highlights the SPAN field, to allow changes to the displayed frequency span. When the SHIFT key is pressed immediately before this key, the STOP field is highlighted, allowing changes to the displayed STOP frequency.

15. **SHIFT** – Used in conjunction with certain buttons to trigger optional operations. Buttons with included SHIFT operations include smaller blue text with the name of the SHIFT operation.

16. **GHz/MHz/kHz** – used for inputting frequencies into the START, STOP, CENTER, SPAN, and cursor fields

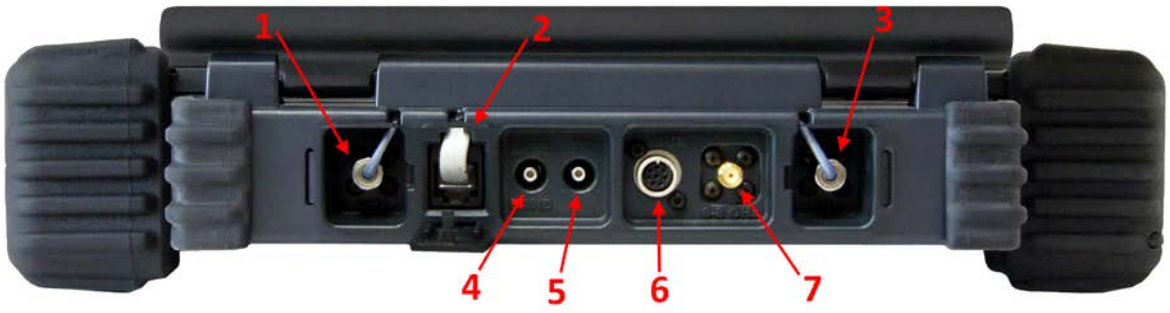
17. **NUMBER KEYS** – used for inputting frequencies into the START, STOP, CENTER, SPAN, and cursor fields and other data

18. **ENTER** – used for confirming selections

19. ← - backspace key

20. **ESC** – used to exit out of certain input screens

Inputs/Outputs/Accessories



Antenna Panel Inputs

1. **8 GHz – 24 GHz Antenna Input** – connection from the antenna panel to the main unit for the 8-24 GHz antennas

2. **Antenna Panel Control** – connection from the antenna panel to the main unit for the control signals used for the automatic antenna switching

3. **0 – 8 GHz Antenna Input** – connection from the antenna panel to the main unit for the 50 kHz to 8 GHz antennas

Auxiliary Inputs/Outputs

4. **Baseband Out** – DC-6 MHz baseband output (See page 78)
5. **IF Out** – 75 MHz IF Out, Center frequency = 75 MHz, 3 dB Bandwidth = 30 MHz. The IF Out port is active anytime that the unit is in Analyze Mode (see page78).
6. **Auxiliary Control Port** – digital control for REI supplied accessories, such as the Multi-Purpose Probe (see page 81)
7. **0 – 8 GHz Aux RF In** – Optional RF input for user supplied antennas. Must manually be switched in the menu (see page 27).

Other Inputs/Outputs/Accessories

8. **Microphone** – Used for correlation and ranging functions (*See page 74)*.
9. **Microphone input** – for connection of an external microphone.
10. **Headphone output** – for connection of headphones to monitor audio from the unit
11. **Power input** – for AC adapter (only use REI supplied AC Adapter)

12. **Hard Reset** – recessed switch for initiating a hard reset to the unit. This button should only be used if the unit has locked up or is not functioning normally due to an unforeseen programming condition.

13. **USB-A connector** – allows connection of USB flash memory for saving data. A USB keyboard or mouse may also be connected to the unit to facilitate entry for the various fields.

14. **Compact Flash slot** – allows connection of compact flash card for saving data.

15. **USB-B connector** – Not currently utilized. Available for future software functionality.

16. **Ethernet connector** – Used to access the OSCOR unit remotely using VNC (Virtual Network Computing) 3rd party software.

17. **Whip Antenna Connector** – for connecting the whip antenna accessory to improve low frequency reception

18. **Directional Antenna *** –Clip the included Vivaldi directional antenna to the antenna panel and connect to the 0 – 8 GHz Auxiliary input on the back of the OSCOR unit for improved directivity in the 1.5 GHz to 8 GHz range.

    The above picture shows the antenna vertically polarized. Rotate the antenna in the clip to allow for vertical or horizontal polarization.

    * The Directional Antenna is not included in some OSCOR models/versions. If the unit purchased did not include this antenna, it can be purchased by contacting REI or an Authorized REI reseller.

19. **Multi-purpose Probe (MPP)** - The MPP is a small portable probe that attaches to the auxiliary port of the OSCOR unit and extends its functionality with the addition of different sensors/antennas to allow the capture and analysis of suspicious signals: Coaxial Connectors, Carrier Current Probe (CCP), VLF Antenna (Loop Antenna), Infrared (IR) sensor, and a Visible Light (VL) sensor. (See page 81.)

QUICK START EXERCISES

This section is intended to provide some short exercises to familiarize the user with some of the basic OSCOR functions and capabilities. These exercises are provided with minimal explanation and assume that the unit is turned off before starting. Detailed explanations of OSCOR functions and procedures are provided in later sections of this User's Manual. Two (2) exercises are provided:

1. Listen to a radio station
2. Basic methods to detect threat transmitters

Exercise 1 – Listen to a Radio Station

This exercise has two parts. The purpose is to gain a quick understanding of how to listen to signals with 2 methods:

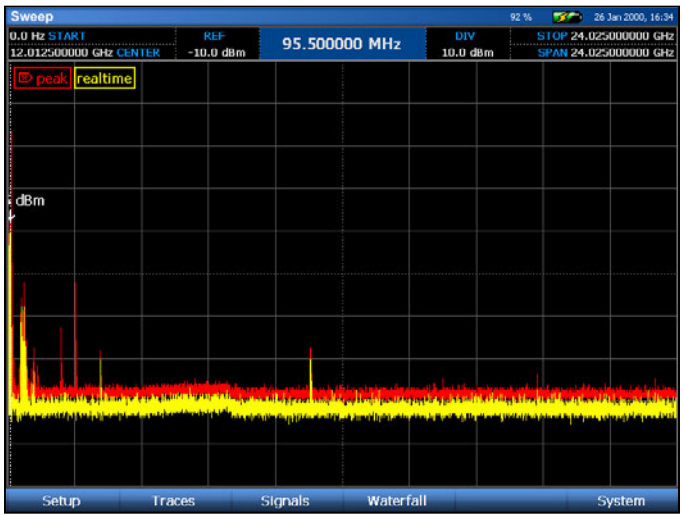
a. Entering a known frequency directly.
b. Using the tuner presets and touch screen controls.

Exercise 1a. – Listen to a radio station by direct frequency entry.

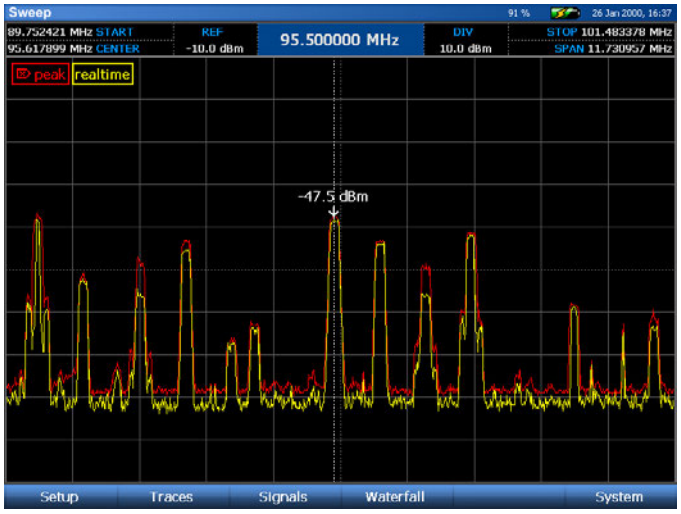
Press the **Power** button to turn on the unit.

Type in a known FM radio station from the numeric keypad. (95.5 MHz is shown in this example; You should use a known station in your area.)

Type "**9**", "**5**", "**.**", "**5**", **MHz**

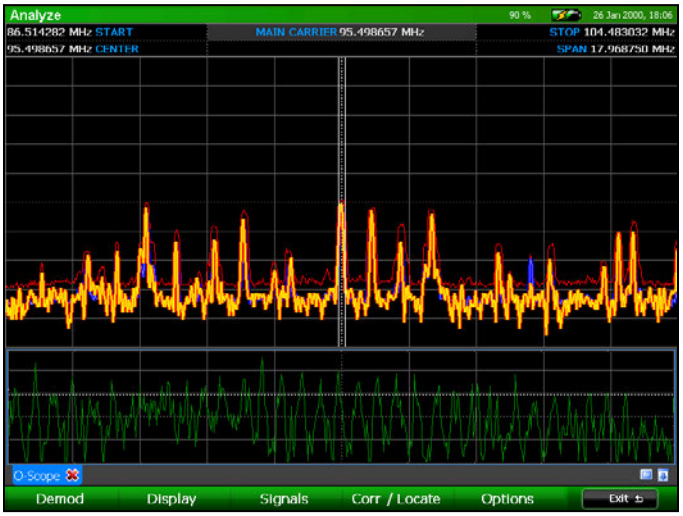


Repeatedly press the **Narrow**button to zoom in on the selected frequency. As you zoom in, the selected frequency will center itself on the screen.



Press **SWEEP/ANALYZE** to enter Analyze mode. Press **Mute** or **Vol Up** to listen to the radio station.

To listen to other known signals, type in the desired frequency or use the rotary knob to move the cursor to adjacent stations.

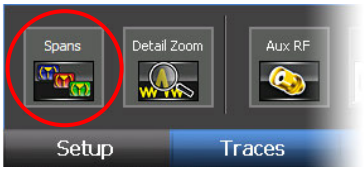


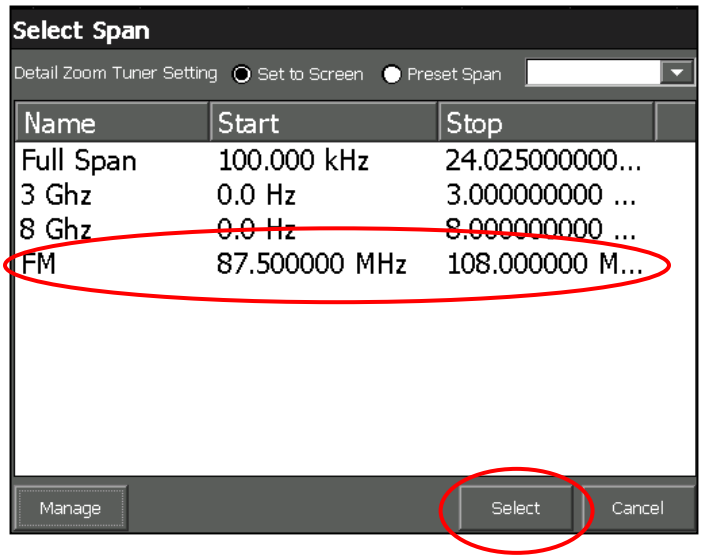
Exercise 1b. – Listen to a radio station using tuner presets & touch controls.

This exercise assumes that the OSCOR unit is again turned OFF.

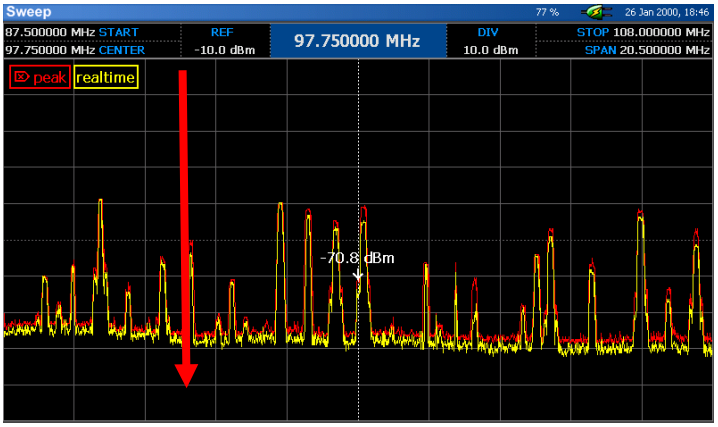
Press the **Power** button to turn on the unit.

Press **F1** to go to the Setup Menu. Select the *Spans* icon. From the Select Span dialog box, tap the *FM* preset with the stylus and then press *Select*. The FM band will be shown in the spectral display.

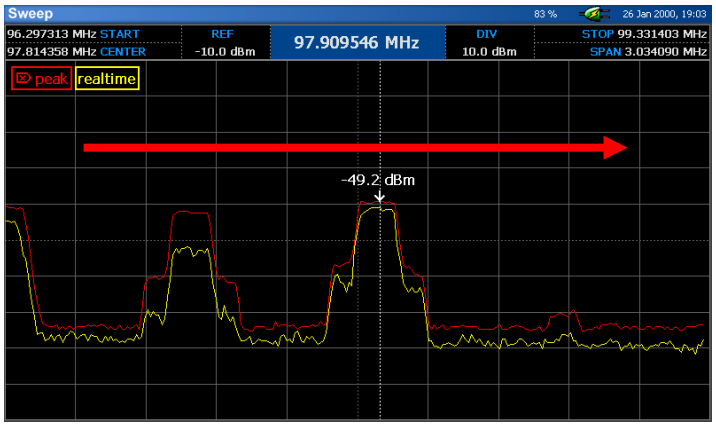




Zoom in on a strong signal in the FM band by touching the screen within the very top screen division and dragging with your finger or the stylus in a downward motion. If you zoom in too far, simply touch the screen within the very bottom screen division and drag in an upward motion.



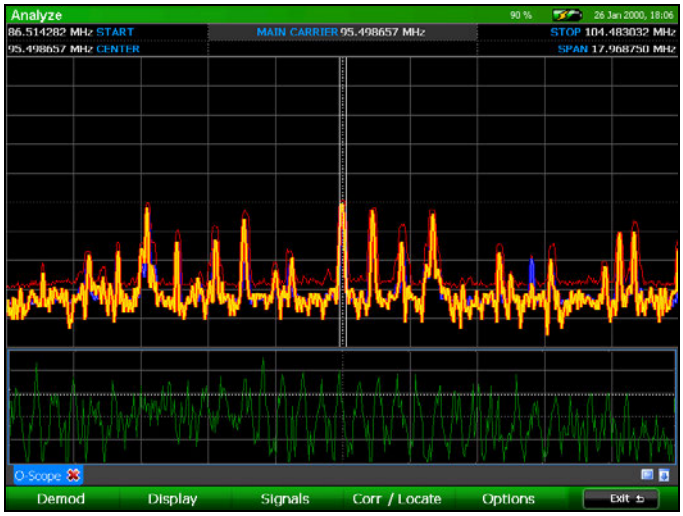
Pan left or right by touching the left side of the screen and dragging right or by touching the right side of the screen and dragging left. You can also zoom and pan at the same time by starting within the top screen division and dragging downward diagonally instead of straight down.



Position the cursor on the desired signal by tapping the signal with your finger or the stylus.

Press **SWEEP/ANALYZE** to enter Analyze mode. Press **Mute** or **Vol Up** to listen to the radio station.

To listen to other known signals, type in the desired frequency or use the rotary knob to move the cursor to adjacent stations.



When you first enter Analyze Mode, the spectral graph will appear in the top portion of the screen, just like Sweep Mode. An oscilloscope view of the demodulated signal will appear in the bottom portion of the screen. Also, by default three traces are displayed in the spectral graph in Analyze Mode: the real time trace, the peak trace, and an average trace.

Using the techniques of this exercise you should be able to quickly go to any signal for spectrum analysis and analog demodulation. To practice, it is recommended that you look at several different signals throughout the frequency spectrum such as pager transmissions, television signals, cellular phone signals, etc… Options for Video Demodulation can be found within the Demod Sub-Menu, just select the *Video* icon. Options for subcarrier demodulation can be found within the Subcarrier Sub-Menu.

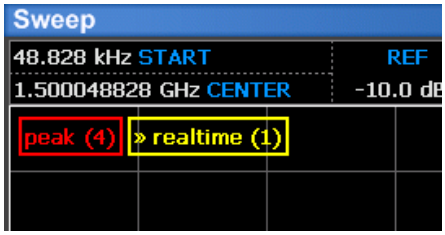
Exercise 2 – Basic Methods To Detect Threat Transmitters

The purpose of this exercise is to introduce methods for locating threat signals using Peak Traces, Math Traces, and the RSSI Locate feature.

For this exercise, you will use some type of RF transmitter such as a cell phone, baby monitor, wireless microphone, or wireless camera. In this documented example a wireless microphone and a wireless 2.4GHz camera were used. This exercise makes the following assumptions:

- There are two rooms being compared, Office A and Office B.
- The transmitters are located in Office A.

Press the **Power** button to turn the unit on.



Two traces are displayed when the OSCOR unit is first started. The real time trace, which is yellow by default, and the peak trace, which is red by default.

Notice the Sweep Countsdisplayed in the top left corner of the spectral display. This keeps track of how many sweeps are included in each displayed trace. The sweep count for each trace is displayed beside the trace name.

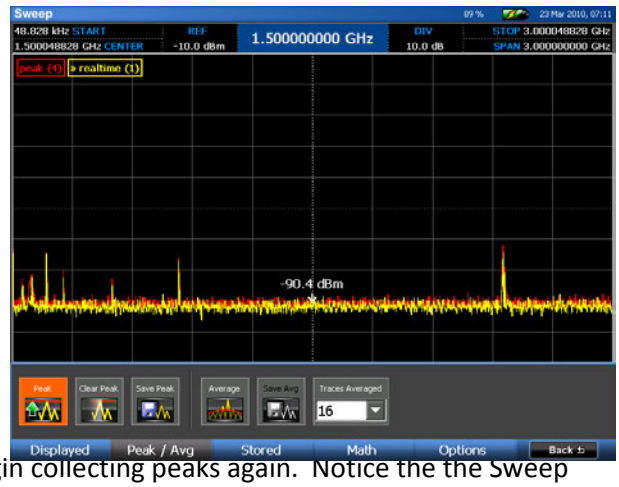
We will begin by collecting a peak trace in Office A.

NOTE: Each time the OSCOR unit is turned off and on, the peak trace automatically clears itself. However, as a precaution (and for instructional purposes) we will manually clear the peak trace for this exercise.

Press **F2** or select *Traces*from the Main Menu to enter the Traces Sub-Menu.

Press **F2** or select *Peak / Avg* to enter the Peak / Avg Sub-Menu.

Select the *Clear Peak* iconfrom the Peak / Avg Sub-Menu to clear the peak trace.



The peak trace will be cleared and will immediately begin collecting peaks again. Notice the the Sweep Count Indicator for the Peak Trace resets to 0.

Allow the peak trace to build for 10-15 sweeps.

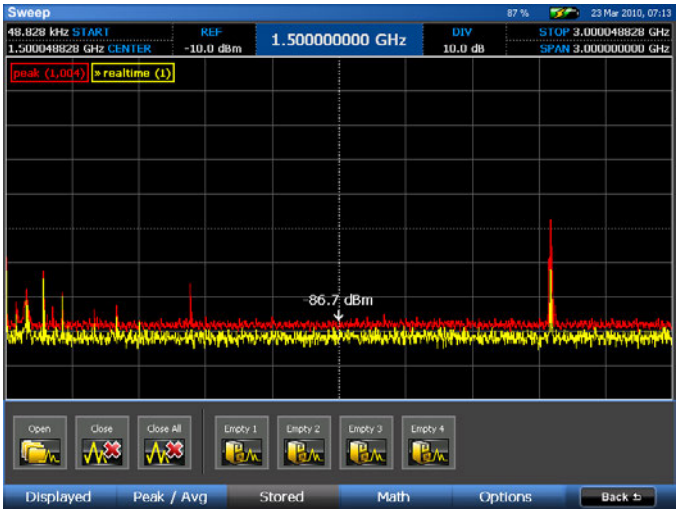
Now we want to save this peak trace in Office A. The Peak / Avg Sub-Menu should still be open from the last step. Select the *Save Peak* iconfrom the Peak / Avg Sub-Menu.

In the dialog box that opens, select a location and a name for the saved trace. (Ex. Office A)

At this point walk into Office B to collect a Peak Trace using the same steps as above. It is important to clear the Peak Trace in Office B to ensure that no signal levels from Office A corrupt the spectrum of Office B. Save the trace in Office B using the steps given above.

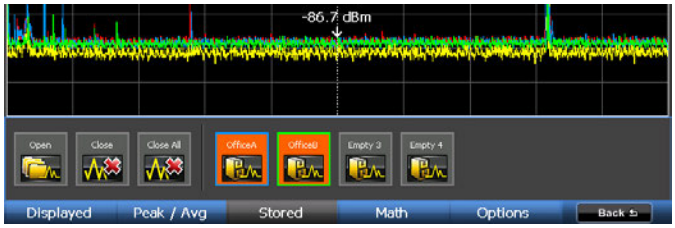
To compare the peak traces, we need to open both of the peak traces that were just saved.

From the Main Menu, press **F2** or select *Traces* from the Menu. From the Traces Sub-Menu, press **F3** or select *Stored* with the stylus.



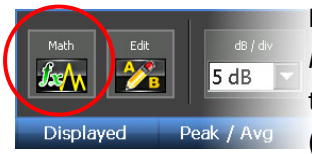
From the Stored Sub-Menu, select the *Open* icon. In the dialog box that appears, find and select one of the traces that you saved. Press **OK**.

This trace will now be displayed on the screen. Notice that the *Empty 1* icon in the Stored Sub-Menu now contains the name of this saved trace and the color of the outline around the icon will match the color of the trace in the spectral display. Repeat the process for both traces

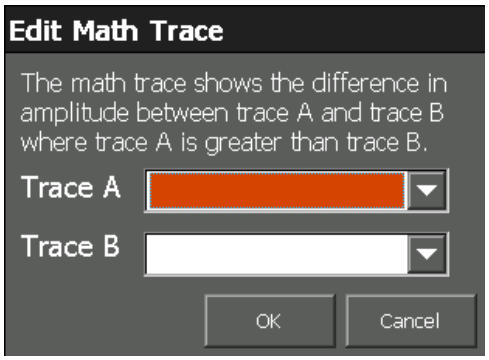


Note: Up to four saved traces can be opened on the OSCOR unit at any given time. After four traces have been opened, a trace must be closed before any additional traces can be opened.

Now we want to create a Math Trace from the two peak traces we just opened. While still in the Traces Sub-Menu, press **F4** or select *Math* from the Traces Sub-Menu.

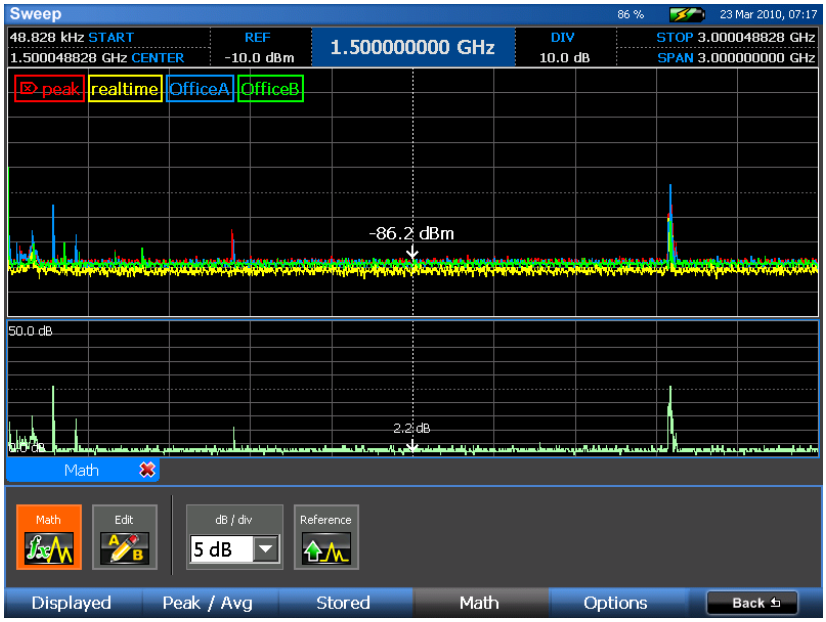


From the Math Sub-Menu, select the *Math*icon.In the Edit Math Trace dialog that opens, select the 1st saved trace (Office A) for Trace A and the 2nd saved trace (Office B) for Trace B. Press **OK**.

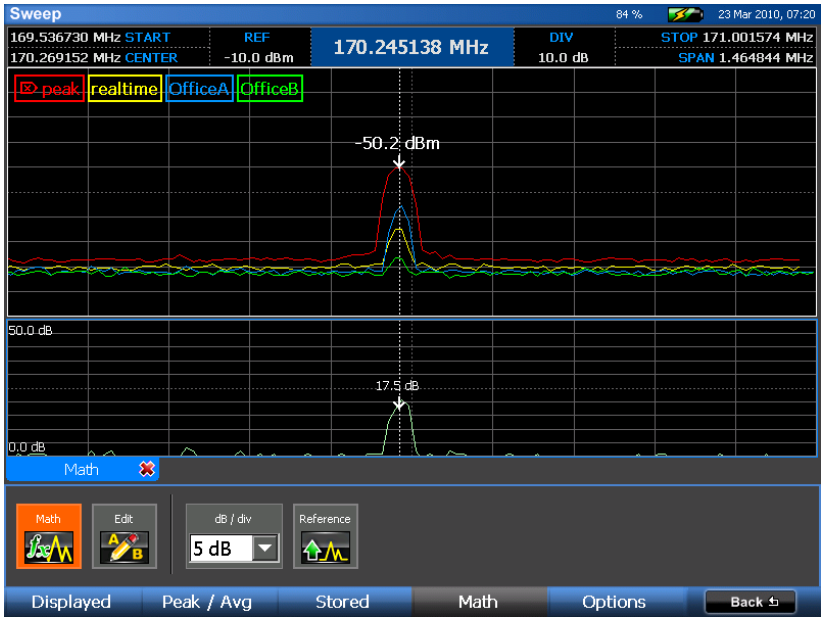

Edit Math Trace
The math trace shows the difference in amplitude between trace A and trace B where trace A is greater than trace B.
Trace A
Trace B
OK
Cancel

Even without your test transmitter, there will be some differences in the traces due to intermittent transmitters in the environment, such as other cell phones, Wi-Fi, etc… The strongest signal that shows up on the difference plot should be your test transmitter. It will be necessary to use the methods from the previous exercise for zooming and navigating the spectral display to locate the test transmitter.

The Math Trace, which should now be displayed, shows a graphical difference of the peak trace generated in Office B compared to Office A. In the screen shot below, the spectrum was zoomed down to a 3GHz window to see the areas of the spectrum that contain the greatest differences. In this example, there are clearly some differences and each area of the spectrum should be closely examined.



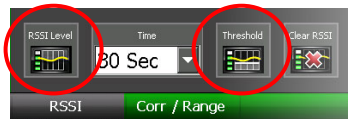
Zooming into one of these areas, it is easy to identify that a strong transmitter exists in Office A at 170.2MHz.



We will now locate this transmitter in Office B using the RSSI Locate function.

Press **Sweep/Analyze** to enter Analyze Mode. In this example, the wireless microphone was demodulated and "listened" to using the audio demod.

To Locate the transmitter select *Corr / Locate* or press **F4**.



Select the *RSSI Level* icon. The oscilloscope view will be replaced with an RSSI graph. (Note: RSSI stands for Relative Signal Strength Indicator.)

Adjust the threshold to be able to see subtle variations in the RSSI level better. Select the *Threshold* icon. Using the Rotary Knob, adjust the threshold level slightly below the signal level for your transmitter. When finished press the **OK** button.

Begin walking around the room carrying the OSCOR unit. Observe the RSSI graph on the bottom portion of the display. As you get closer to the transmitter, the level of this graph will increase indicating the close proximity of the transmitter. As you walk further away from it, the RSSI level will decrease. You may need to use the *Threshold*icon and the rotary knob to adjust the RSSI level graph; be sure to press the OK button or the ENTER button to set the threshold.

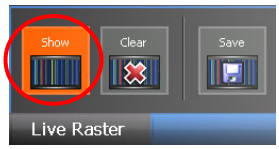
Locating the Wireless Camera

Using a similiar procedure, the Wireless Camera is identified, demodulated, and located.

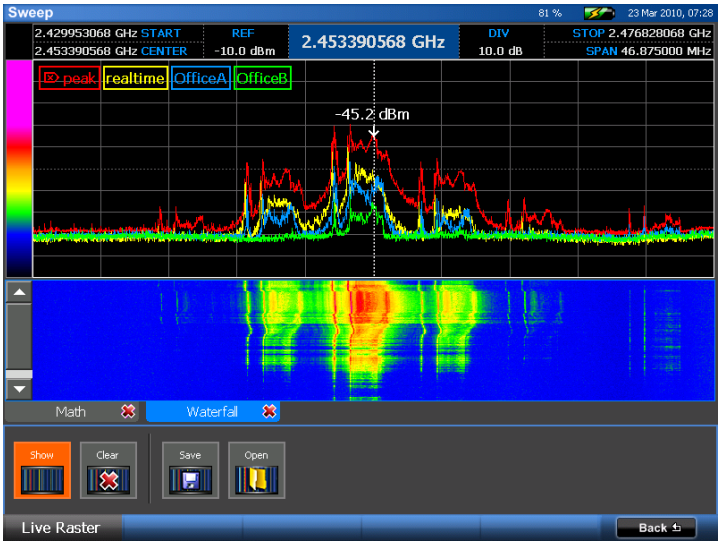
In this example, there was a Wireless LAN transmitter in Office A that occupied the same frequency as the camera. However, careful evaluation of this band and the video revealed the camera within the 2.4GHz band.

You can use the previous location method of monitoring the signal RSSI level as you walk around the room, but for this example we will use the Live Waterfall Raster to locate the wireless camera.

Press F4 or select *Waterfall* from the main menu. Then select the *Show*icon.

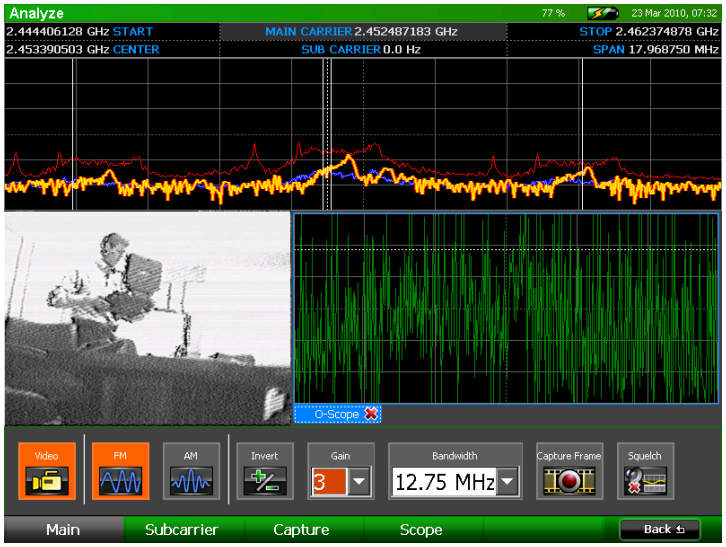


Walk around the room moving the OSCOR unit close to various surfaces in the room until the signal level becomes very strong.



At this point, it is easy to see the shape of the wireless camera transmission in comparison to the normal Wi-Fi traffic. This procedure should also work for many more types of transmitters.

To view the video transmitter, press the **Sweep/Analyze** button, then select the *Video* icon from the Demod Sub-Menu. You may need to adjust the tuning or the demodulation parameters.



These Quick start exercises do not cover all of the functionality of the OSCOR unit.

However, these exercises are given to provide some quick examples of how to use the product and to familiarize the user with many of the main functions and concepts.

It is recommended to use the entire manual for more detailed explanations of the OSCOR unit functions.

SET-UP & BASIC OPERATION

The OSCOR is a stand-alone spectrum analyzer with a built-in antenna panel ready to be used right out of the box. Depending on your application, some adjustments to the default settings may need to be made.

Power Control and Battery Charging

To turn on your OSCOR unit, ensure that a charged battery is in the unit or connect the supplied AC adapter and press the power button (see page 2). During operation, to turn off your OSCOR unit, press and release the power button or select the *Shutdown* icon from the System Sub-Menu.

Press and hold the power button until the unit shuts off to perform a firmware reset. This method should ***only*** be used if the unit has locked up and the normal shutdown methods are not functioning.

The OSCOR unit has a built in battery charger. To charge the battery, simply plug the supplied AC adaptor into the unit with the battery in the OSCOR unit. Expected charge time is 1.5 hours; expected run time is 3 hours.

Note: It is recommended that the OSCOR battery be recharged on a regular basis during extended periods of storage (3 months or more) to prevent damage to the battery. Additionally, when storing the OSCOR for long periods (1 month or more), it is recommended that the battery be removed from the unit and placed in the storage compartment in the case. Storing the OSCOR with the battery in the unit can deplete it more rapidly, potentially shortening the life of the battery.

Updating the Software and Firmware

Software updates, provided in the form of an .O2update file, will be made available by contacting REI at sales@reiusa.net. To update your OSCOR unit:

1. Place the downloaded .O2update file on a USB thumb drive or Compact Flash card and connect the media to the OSCOR unit.

2. From the Main Menu, select *System* or press **F6**.

3. From the *System* Sub-Menu, select the *Update* icon. In the dialog box that opens, select the media containing the update file (\USB or \CF), highlight the .O2update file, and press the OK button.

4. The system will ask for confirmation to run the update. Select *Yes* or press **F5** to run the update. Select *No* or press **F6** to cancel the update.

5. The OSCOR will now update the software. *Note: Depending on the extensiveness of the update, the process could take several minutes and may shut down and restart the unit several times.*

6. After a successful update, remove the thumb drive or compact flash card and save the .O2update file as a back-up.

Notes

- Contact REI at sales@reiusa.net for software update notification.

- .o2update files also contain updates to the firmware for the MPP. When an MPP is connected to the OSCOR unit (see page 81) if the software on the unit is incompatible with the software on the MPP, the unit will automatically update the firmware on the MPP. A dialog box will appear when the MPP is connected informing you that an MPP firmware update is required. Press *OK* to begin the update and then follow any subsequent screen prompts.

Help File

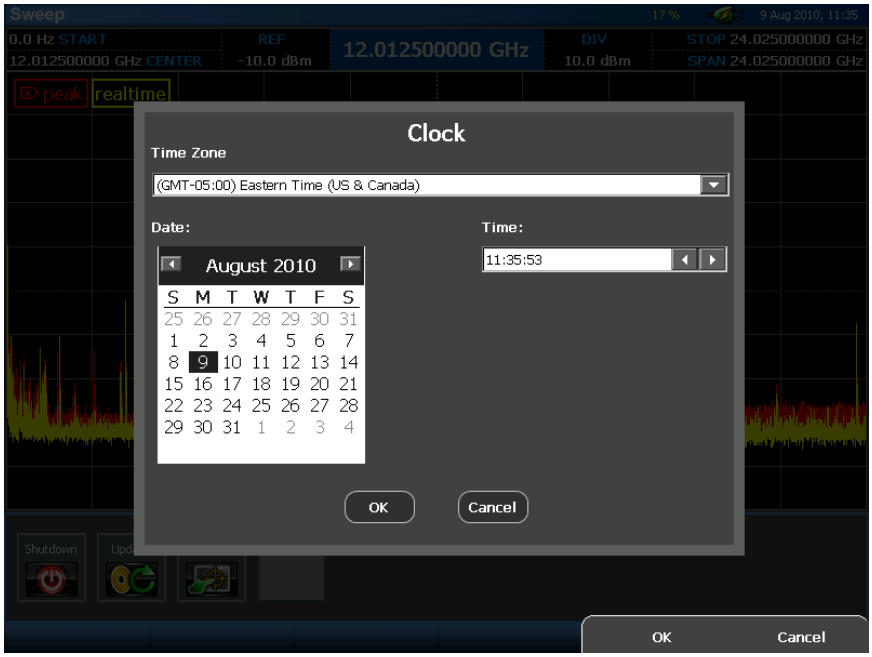
To access the on-screen help file, press the **HELP** key. The contents of the help file will vary depending on the mode the OSCOR is in when the help file is launched.

Within the help file there are several methods of navigating through the information:

- Click on hyperlinks with the stylus to jump to the referenced location in the help file.
- Click *Back* or press **F1** after clicking on a hyperlink to return to the previous file location.
- After clicking *Back* to return to previous file locations, the *Forward* button or **F2** will jump forward through your list of previous file locations.
- Press the **UP ARROW** key and the **DOWN ARROW** key to scroll the text up or down.
- Click and drag the scroll bar on the right side of the screen to scroll the text up or down.
- Press **SHIFT** + **UP ARROW** or **SHIFT** + **DOWN ARROW** to page up or page down within the help file.

To close the on-screen help file, select *Close* or press **F6**.

Setting the Time Zone, Date, and Time



Setting up the time zone, date, and time will give you accurate timestamps on any recorded data. To set up this information on the OSCOR unit:

1. From the Main Menu, select *System* or press **F6**
2. From the System Sub-Menu, select the *Set Time* icon.
3. In the dialog box that opens, select the corresponding time zone for your area from the *Time Zone* drop down box.
4. To quickly adjust the current date, tap the month on the displayed calendar with the stylus and select the current month from the drop down list that appears. Tap the year with the stylus and enter the current year using the numeric keypad or adjust using the scroll arrows next to this item. After setting the month and year, select the current day from the displayed calendar.
5. To quickly set the current time, each portion of the displayed time (hour, minute, seconds) can be selected individually and entered using the numeric keypad or adjusted using the scroll arrows next to the time display.
6. Select the OK button or press **F5**.

Touch Screen Calibration

The easiest method to access and control OSCOR functions is to use the built in Touch Screen. There is a stylus located in the grip which will give the most precise control on the touch screen. In order to properly align the touch screen to the display, it may be necessary to calibrate the touch screen.

To calibrate the touch screen:

1. From the Main Menu select System or press **F6**.
2. Select the *Touch Cal* icon from the System Sub-Menu.
3. Follow the on-screen instructions.

Note: Calibration should only be required after a complete software update is performed.

Saving Screen Shots to Thumb Drive

To assist in report-writing, the OSCOR provides the ability to capture screen shots from the display. Screen shots can be stored as PNG or BMP (bitmap) files and can be saved to a Compact Flash card or to a USB thumb drive. To use this function, insert a Compact Flash card into the compact flash slot *or* insert a thumb drive into the USB port on the front of the OSCOR unit. Then press the following key sequence to store the current screen image:

- SHIFT
- HELP

If successful, a Save Dialog box will open. The currently selected media, either compact flash (\CF) or thumb drive (\USB) will be displayed at the top of the dialog box. To change where you want to store the image file, press *Change* in the Media section on the right hand side of the dialog box and then select either \CF or \USB. After naming the file and selecting a file type, press *OK* to save the image file.

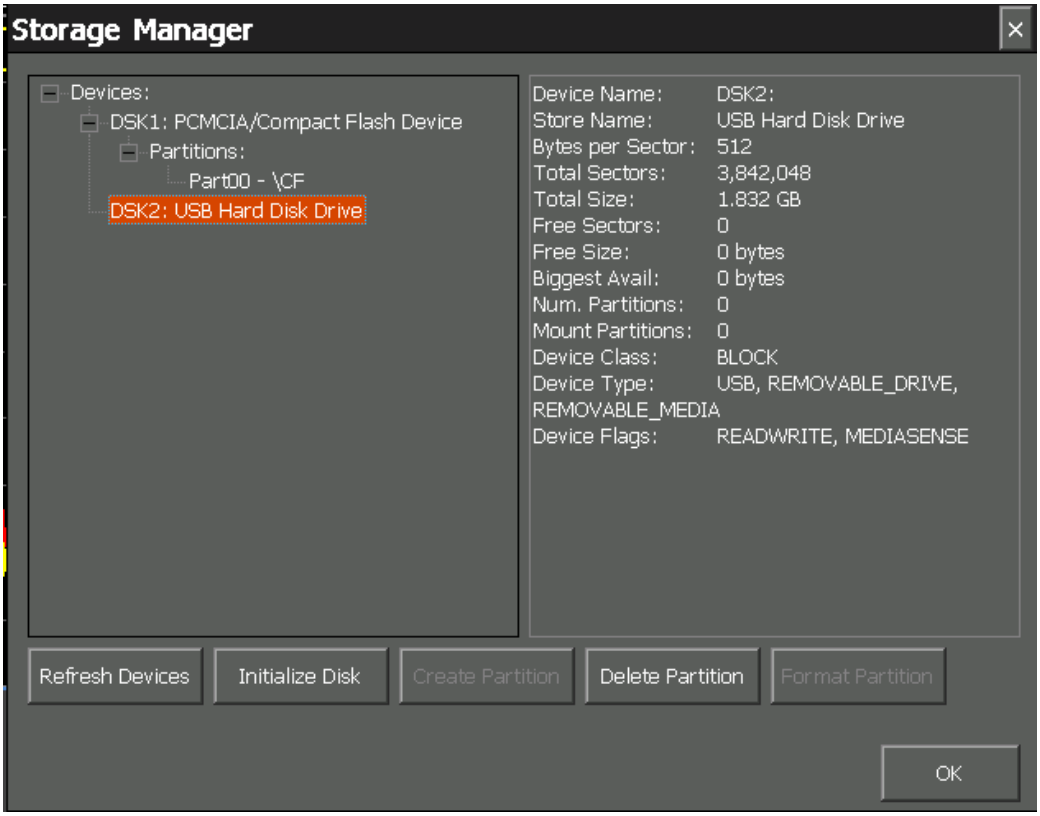
Using the Storage Manager

USB Hard Drives must be formatted with a FAT file system, such as FAT32, for use with the OSCOR unit. Hard drives formatted with the NTFS file system will not be recognized by the OSCOR. Windows operating systems limit the storage capacity of a FAT32 partition to less than 32 GB when formatting. Third party software does exist which will allow you to format a larger partition using FAT32. To assist with setting up large capacity drives, the OSCOR unit features a storage manager that will partition and format any size hard drive using FAT32.

To format a USB hard drive using the Storage Manager:

1. Connect the USB hard drive to the USB-A connector on the front of the OSCOR unit.

2. From the Main Menu select System or press **F6**. Select the *Storage* icon from the System Sub-Menu.



3. The storage manager will open. Connected storage devices will be shown in the tree list on the left side of the storage manager window.

4. Find and Select the device you wish to format from the tree list in the storage manager. Properties for the device will be displayed on the right side of the storage manager window. Any existing partitions will be listed below the device name in the tree list. If Free Size (listed in the property pane on the right side of the storage manager) is equal to 0 bytes and there are no existing partitions for the device, you will need to initialize the disk. Press *Initialize Disk*. If Free Size is not equal to zero or the *Initialize Disk* button is grayed out skip to the next step. If a partition already exists on the device, skip to step 6.

5. Make sure that the device that you want to format is still selected. Press *Create Partition*. In the dialog box that appears, type a name for the partition and select *OK*. The storage manager will only create one partition per device. The partition size will automatically be the maximum size possible for the given storage device.

6. Select the partition that you wish to format. If the partitions are not shown in the tree list, select the "+" sign next to "Partitions:" under your device in the list. Select *Format Partition*. In the dialog box that opens, confirm that you would like to format the partition by selecting *Yes*. ***WARNING*** Any existing data on the storage device will be lost! Make sure to transfer any data you wish to keep to another device before performing the Format Partition function.

Several other tasks can be performed from the Storage Manager:

- *Refresh Devices* – When the storage manager is first open, it will automatically detect all storage devices connected to the OSCOR. However, while the storage manager is open, if devices are connected or disconnected, it may be necessary to press *Refresh Devices* to refresh the tree list.
- *Delete Partition* – Select a partition in the tree list and press *Delete Partition* to delete the partition. ***WARNING*** Any existing data on the partition will be lost! Make sure to transfer any data you wish to keep to another device before performing the Delete Partition function.

Resetting to Factory Defaults

If you have changed any of the settings on your OSCOR unit, such as trace colors or preset spans, it is possible to reset the unit to the default conditions shipped from the factory.

To reset to factory defaults:

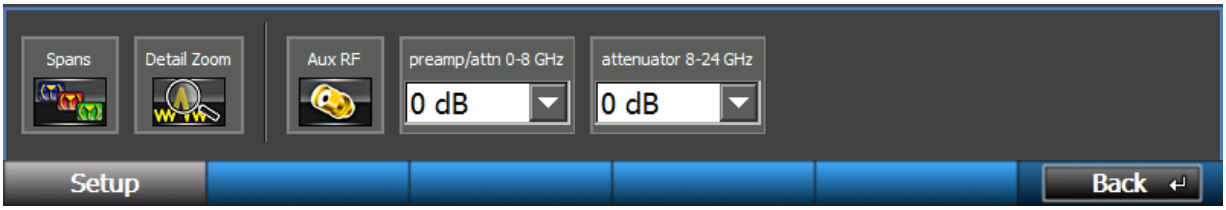
1. From the Main Menu, select *System* or press **F6**.
2. From the Systems Sub-Menu, select the *Defaults* icon.
3. The system will ask for confirmation to restore system settings to their defaults. Select *Yes* or press **F5** to restore the default settings. Select *No* or press **F6** to cancel.

The following stored system settings will be restored to their default settings:

- Trace Colors
- Custom Spans
- Color Gradient Settings
- Visibility state of graph adornments, such as the Trace Legend and Sweep Counts

Note: If you have created several custom spans that you wish to save, you may want to export these custom spans (see page 25) before resetting to factory defaults, so that you can easily restore them afterwards.

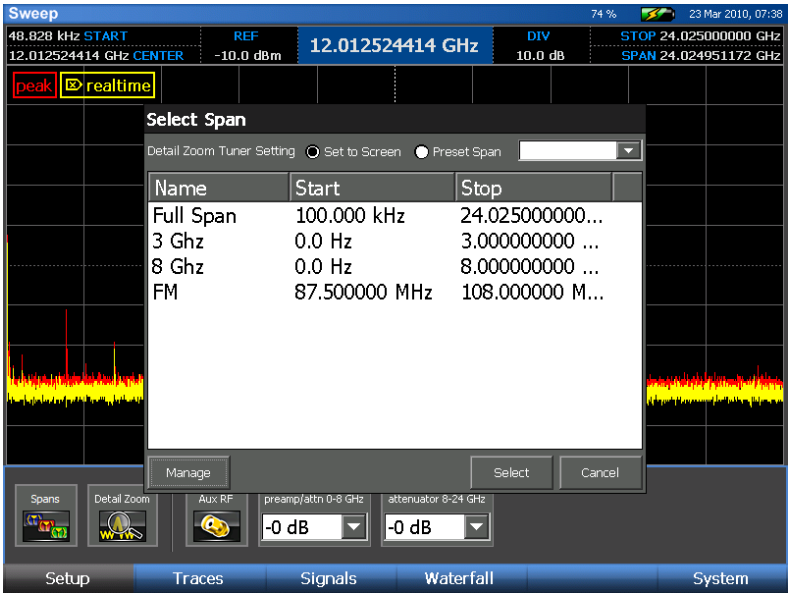
Setting up the Tuner



Preset Spans

The range of frequencies swept by the tuner, or tuner span, can be adjusted during operation by changing one or more of the spectral parameters (see page 31). Custom spans may be configured, named, and stored in memory for easy recall later. Several default tuner spans are available on the OSCOR from the factory:

- Full: The tuner will sweep the entire frequency range available on the OSCOR (100 kHz to 24 GHz for 24 GHz models and 100 kHz to 8 GHz for 8 GHz models)
- 3 GHz: The tuner will sweep from 100 kHz to 3 GHz
- 8 GHz: The tuner will sweep from 100 kHz to 8 GHz (available on 24 GHz models)
- FM: The tuner will sweep the FM radio broadcast band, from just below 87.5 MHz to 108 MHz



To change the tuner span:

1. From the Main Menu select Setup or press **F1**.
2. Select the *Spans* icon from the Setup Sub-Menu.
3. In the Select Span dialog box that appears, a list of available user spans will be displayed.

4. Highlight the desired user span and press *Select*. The dialog box will close and the new span will be applied.

Note: If Detail Zoom is on (see page 44), the selected span will apply to the Detail View and not to the tuner. If the selected span is outside the range of the current tuner span, then the new span will not be applied to the Detail View.

Managing Preset Spans

Custom spans can be created and stored for later recall. After creating a custom span, it will be displayed in the list of available tuner spans.

1. From the Main Menu select Setup or press **F1**.
2. Select the *Spans* icon from the Setup Sub-Menu.
3. In the Select Span dialog box that appears, select *Manage*.
4. In the Manage User Spans dialog box that appears, select *New*.
5. In the Edit Span form that opens, enter a name for the custom span, a start frequency, and a stop frequency. Press *OK*.
6. The new custom tuner span will now be available in the list of tuner spans.

Several other user span maintenance tasks can also be performed from the Manage User Spans dialog box:

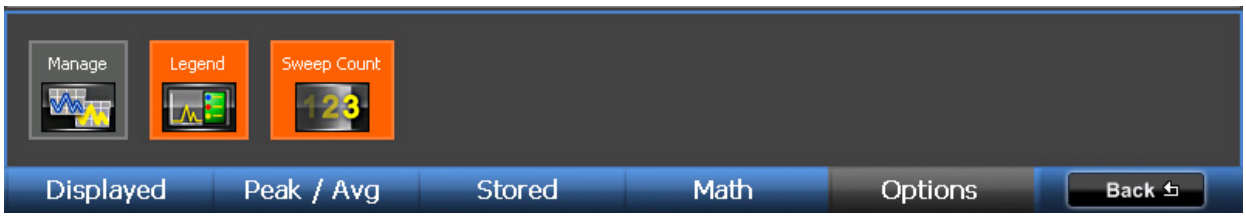
- Edit: Allows you to edit the configuration for the highlighted custom span.
- Delete: Deletes the highlighted custom span.
- Import: Imports user spans from a previously exported user spans file.
- Export: Exports current user spans, including any custom spans, to a comma separated values file (.csv).
- Defaults: If any of the factory default tuner spans get deleted, this function restores them so that they are once again displayed in the list of available tuner spans. Defaults will also remove any custom spans that have been created. If you have custom spans that you wish to save, export them before using the *defaults* function, so that you can easily restore them afterwards.

Setting up the Display

Several items on the display can be customized depending on the information that needs to be seen on the screen:

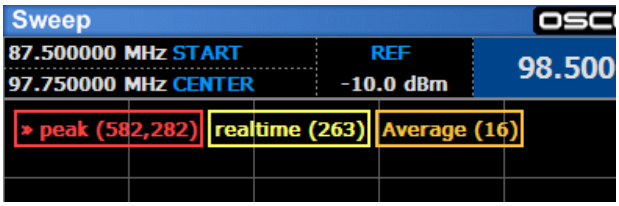
Showing/Hiding the Trace Legend

A legend is available to help identify traces on the screen. The legend is turned on by default and is located in the upper left corner of the spectral graph (see page 30).



1. From the Main Menu, select *Traces* or press **F2**.
2. From the Traces Sub-Menu, select *Options* or press **F5**.
3. To show or hide the legend, press or toggle the Legend icon.

Showing/Hiding the Sweep Counts



It is possible to have the trace legend display the number of sweeps included in the real time trace, peak trace, average trace(if displayed), and any open stored traces. Most of the time, especially when the tuner is sweeping the full 24 GHz span, the sweep count for the real time trace will just be 1. However, when the tuner span is set to a small range, the tuner will sweep the given spectrum many times before the display is updated. In these cases the sweep count for the real time trace could be as high as 100 or more and the real time trace will actually be a peak trace of the sweeps that have occurred since the last screen update. A sweep count of 582,282 for a peak trace indicates that there are 582,282 sweeps of the spectrum included in that peak trace. A peak trace will continue building and its sweep count will continue increasing until the peak trace is cleared (see page 34). The Average Trace sweep count will indicate the number of sweeps included in the displayed Average Trace. Sweep counts are turned on by default. To show or hide the sweep counts in the trace legend:

1. From the Main Menu, select *Traces* or press **F2**.
2. From the Traces Sub-Menu, select *Option* or press **F5**.
3. To show or hide sweep counts, press or toggle the *Sweep Count* icon.

Adjusting the Input Attenuation

Since the OSCOR is a highly sensitive receiver, it is possible for very strong signals to have an overloading effect on the receiver circuitry. Receiver overload (see page 60) is evidenced by strong signals appearing at harmonic frequencies and/or from intermodulation distortion. The built-in attenuator should be turned on to reduce or eliminate the RF overload. Two separate attenuators exist for the 24 GHz models: one attenuator for the 0-8 GHz range and a separate attenuator for the 8-24 GHz range. Each attenuator offers three different levels of RF attenuation.

1. From the Main Menu, select *Setup* or press **F1.**
2. There are two different drop-down boxes in the Setup sub-menu for the two separate attenuators (24 GHz models only). The drop-down box labeled “preamp/attn 0-8 GHz” sets the attenuation level for the 0-8 GHz range and the drop-down box labeled “attenuator 8-24 GHz” sets the attenuation level for the 8-24 GHz range. Select or touch the current attenuation level for the desired range with the stylus. A list of the available levels will pop up.
3. To turn on the RF attenuator, select one of the three available attenuation levels: -10 dB, -20 dB, -30 dB *(Note: the “+10 dB” value on the 0-8 GHz range activates the built-in pre-amp, see “Using the Built-in Pre-Amp” below.)*
4. To turn off the RF attenuator, select 0 dB

Using the Built-in Pre-Amp

In certain situations when dealing with low level signals which are partially obscured by the noise floor, it may be necessary to boost the signal strength. This can be accomplished by using the built-in pre-amp provided on the OSCOR unit. The built-in pre-amp only affects frequencies in the 0-8 GHz range. To turn on the pre-amp:

1. From the Main Menu, select *Setup* or press **F1**.
2. In the drop-down box labeled “preamp/attn 0-8 GHz” change the value to “+10 dB”.

Using an External Antenna

There may be situations where you wish to use another antenna with the OSCOR unit, such as the included Directional Antenna (see page 7). An Auxiliary RF input from 0-8 GHz is provided on the unit for this purpose.

1. Connect an external antenna to the Auxiliary RF input (see page 5) on the back of the OSCOR unit. The Auxiliary RF connector is an SMA female connector. If your antenna uses a different

type of connector it may be necessary to use an adaptor to connect the antenna to the OSCOR unit.

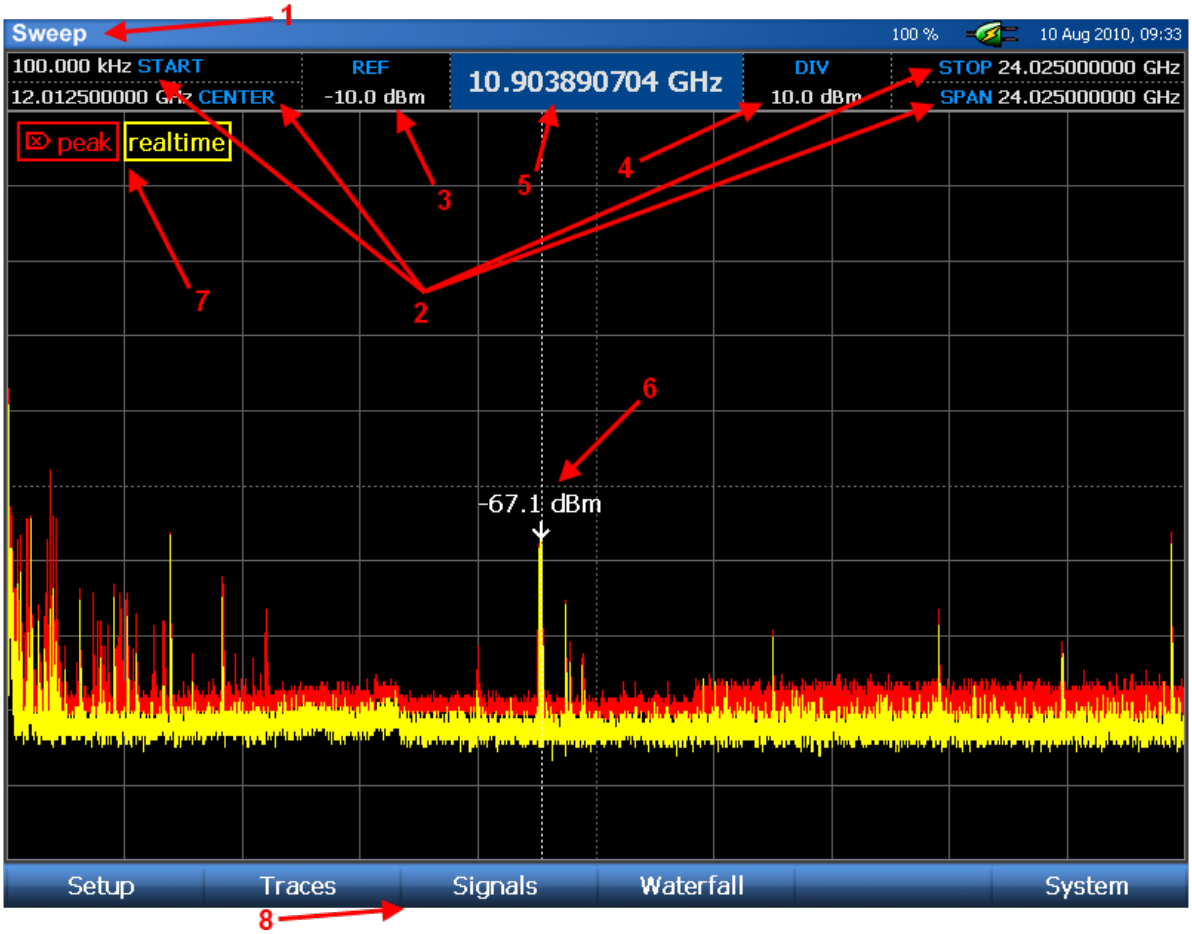
2. From the Main Menu, select Setup or press **F1.**
3. Select the *Aux RF* icon from the Setup Sub-Menu. When the background of the *Aux RF* icon is orange, the 0-8 GHz Auxiliary RF input is active. When the background of the *Aux RF* icon is gray, the 0-8 GHz Antenna input is active.
4. The tuner will now switch to your connected antenna.

SWEEP MODE

Sweeping the RF Spectrum

When you first power up your OSCOR unit, it will by default enter Sweep Mode. This section describes the controls for navigating the spectrum and the tools necessary for doing trace analysis in Sweep Mode.

Sweep Mode Screen Elements



1. **Mode Indicator** – indicates current mode

2. **Spectral Parameters** (Start, Stop, Center, Span) – these parameters display information pertaining to the frequency range that is being scanned by the OSCOR's tuner.

3. **Reference Level** – indicates current reference level. The reference level can be adjusted by selecting the reference level indicator with the stylus and either entering a new reference level with the numeric keypad or scrolling through possible values using the rotary dial. To reset the

reference level to the default, press the **OK** button and select *Default Range* from the context menu that pops up. This will also reset the dBm/div value to default.

4. **dBm/div indicator** – indicates the number of dBm per screen division. The dBm/div value can be adjusted by tapping twice on the dBm/div indicator with the stylus and selecting a new value from the drop down list. To reset the dBm/div value to the default, press the **OK** button and select *Default Range* from the context menu that pops up. This will also reset the reference level to default.

5. **Cursor Value** – indicates the cursor frequency position

6. **Cursor** – dotted vertical line. A small arrow indicates the power level at the current cursor position. The value is displayed just above the arrow.

7. **Legend** – indicates which traces are currently displayed on the screen and identifies the color of each trace. Sweep counts are not shown in this screenshot, but can be displayed in the legend (see page 26).

8. **Menu Options** – Menu options are displayed along the bottom edge of the screen.

Navigating the Spectral Display

The OSCOR unit is capable of scanning and displaying a large portion of the RF spectrum. In order to fully analyze the RF energy in a given location, it may be necessary to focus on smaller portions of the RF spectrum at a time. This can be accomplished by using one of several available methods:

- Center on Cursor: If your spectral display is not currently set to maximum span and your cursor is not at the center of the spectrum, press the **OK** button and select *Center on Cursor* from the context menu that pops up. The OSCOR display will move the frequency of the current cursor position to the center of the display. The OSCOR will not change the span of the display, so if the span is near the maximum and the cursor is too far off center, then the OSCOR will only position the cursor frequency as close to center as possible without changing the span. *Note: If no context menu appears when OK is pressed, tap the spectral display with the stylus or your finger and then press **OK** again.*

- Click & Drag - Pan: If your spectral display is not currently set to maximum span, c*licking* on the right side of the spectral display with the stylus or your finger and *dragging* to the left will pan the spectral display to higher frequencies. *Clicking* on the left side of the spectral display with the stylus or your finger and dragging to the right will pan the spectral display to lower frequencies. Your *SPAN* parameter will remain constant, but your *START*, *STOP*, and *CENTER* parameters along with the CURSOR position will change as the spectral display pans.

- Arrow Keys – Pan: If your spectral display is not currently set to maximum span, pressing the *RIGHT ARROW* key will jump up one half screen to the next set of higher frequencies. Pressing

the *LEFT ARROW* key will jump the currently displayed span down one half screen to the next set of lower frequencies. Your *SPAN* parameter will remain constant, but your *START, STOP,* and *CENTER* parameters along with the CURSOR position will change as the spectral display pans.

- Click & Drag – Narrow: *Clicking* within the very top screen division and dragging with your finger or the stylus in a downward motion will decrease or narrow the size of the displayed span. You may also pan at the same time that you are narrowing the span by dragging downward diagonally as opposed to straight down.

- Click & Drag – Expand: *Clicking* within the very bottom screen division and dragging with your finger or the stylus in an upward motion will increase or expand the size of the displayed span. You may also pan at the same time that you are expanding the span by dragging upward diagonally as opposed to straight up.

- Narrow key: *Pressing* the *NARROW* key will decrease or narrow the size of the displayed span by one half of the current value until the minimum span is reached.

- Expand key: *Pressing* the *EXPAND* key will increase or expand the size of the displayed span by a factor of two until the maximum span is reached.

- Max key: *Pressing SHIFT* + *EXPAND (MAX)* will increase or expand the size of the displayed span to the maximum frequency span.

- Min key: *Pressing SHIFT* + *NARROW (MIN)* will decrease the size of the displayed span to the minimum frequency span.

Changing the Spectral Parameters

There are several ways to change the spectral parameters:

- With the stylus, double click any of the spectral parameters (Start, Stop, Center, Span). A virtual keypad will appear on the screen. Using the virtual keypad, enter the desired value for the selected spectral parameter, then press one of the *unit* keys (kHz, MHz, GHz) to initiate the change. Press *ESC* to discard any changes.

- Select the desired spectral parameter with the stylus so that it is highlighted. Using the number keypad on the OSCOR unit, enter the desired value, then press one of the unit keys (kHz, MHz, GHz) to initiate the change.

- Select the desired spectral parameter with the stylus so that it is highlighted. Turn the rotary knob to change the value of the selected spectral parameter.

- Press the **CENTER**, **SPAN**, **SHIFT** + **CENTER**, or **SHIFT + SPAN** button to highlight the *CENTER*, *SPAN*, *START*, or *STOP* parameters respectively. Enter a value using the number keypad, followed by a unit key (kHz, MHz, GHz) to initiate the change or turn the rotary knob to change the selected parameter's value.

Note: The minimum START frequency in sweep mode is 100 kHz. If you are using an auxiliary antenna and want to evaluate signals down to 50 kHz, use Analyze Mode (see page62).

Changing the Position of the Cursor

There are several ways to change the position of the cursor:

- To move the cursor to the center of the screen: Press the **OK** button. Select *Cursor to Center* from the context menu that pops up. *Note: If no context menu appears when OK is pressed, tap the spectral display with the stylus or your finger and then press **OK** again.*

- With the stylus, double tap the cursor value at the top center of the screen. A virtual keypad will appear on the screen. Using the virtual keypad, enter the desired value for the cursor, then press one of the *unit* keys (kHz, MHz, GHz) to initiate the change. Press *ESC*, if you do not wish to change the cursor position.

- Select the cursor value at the top center of the screen with the stylus so that it is highlighted. Using the number keypad on the OSCOR unit, enter the desired value, then press one of the unit keys (kHz, MHz, GHz) to initiate the change.

- Select the cursor value at the top center of the screen with the stylus so that it is highlighted. Turn the rotary knob to change the cursor position.

Note: Setting the cursor to a value that is not within the currently displayed span will reset the START & STOP frequencies of the current span, so that the cursor at the new value will be centered on the screen within a span of the current bandwidth.

RF Spectrum Trace Display Modes

The OSCOR provides several different ways to view the RF spectrum in sweep mode. These methods are very useful to detect and find sophisticated threats such as Spread Spectrum, Frequency Hopping, and Burst transmitters. These trace modes are defined below:

- Real Time Trace – Provides the most recent view of the RF spectrum. This data is not stored.

- Peak Trace – this trace is updated based on the maximum values measured from the real time trace data. The peak trace is constantly being updated until it is cleared and then the peak trace memory buffer is reset. Peak traces can be saved for later analysis.

- Average Trace –Trace display mode developed by averaging the real time trace data. Average traces can also be saved for later analysis.

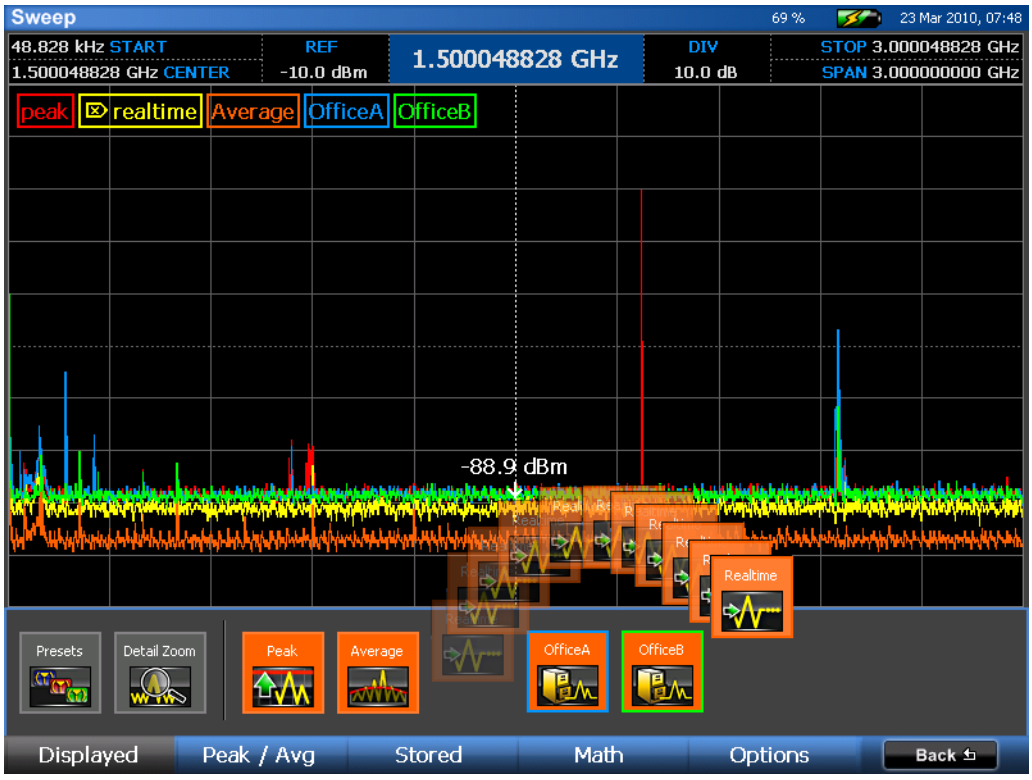
- Math Trace – Displays differences in amplitude between any two open traces. Useful for comparing traces taken from different locations or taken at different times.

To turn on/off and reorder the displayed view of traces:

1. From the Main Menu, select *Traces* or press **F2**.

2. Select the desired trace icon (i.e. Realtime, Peak, Average etc…) from the *Displayed* Sub-menu to turn off or on. *Note: If the Peak or Realtime trace view is turned off then corresponding sweep count parameter will also disappear from the sweep count indicator and the trace indicator will disappear from the Legend, if displayed.*

3. To reorder the layers of the displayed traces, use the stylus to select and drag an icon to the desired position.



The paragraphs below describe these display modes in greater detail.

Real Time Trace

The real time trace is displayed by default when the OSCOR unit is first powered on. It is yellow by default. It is updated as quickly as the display can be updated and may itself be composed of the peak data from more than one sweep. Depending on the tuner span, more than one sweep of the spectrum may be completed before the current trace is updated on the display. If the tuner is set to a very narrow span, the receiver may be able to complete several sweeps of the given span before the display is able to update. If an updated spectrum display contains data from more than one sweep, the resulting trace will be a peak trace of those sweeps. The sweep count indicator will display the number of sweeps contained within each spectral display update.

Peak Trace

Many RF signals only transmit at random times and are therefore very difficult to detect. These types of signals include pagers, cellular phones, police and aircraft radios, etc… Sophisticated bugs that do not stay on the same frequency for very long or only transmit at certain intervals are very difficult to locate. These signals may be Frequency Hopping, Spread Spectrum, or Burst Bugs. For this reason, the OSCOR was designed with a Peak Trace Display Mode. In this mode, the OSCOR will display the peak signal that occurs at each frequency as it continuously scans creating an envelope of all transmissions. After a period of time, the envelope of a frequency hopping bug or a burst bug will be displayed. The peak trace is displayed by default when the OSCOR unit is first turned on. The peak trace is red by default.

It is important to clear the Peak Trace Data after entering each new environment in order to analyze each environment and to compare different rooms in the same environment. With the OSCOR, the Peak Trace data for each room can be stored for future comparison.

To Clear Peak Trace Data:

1. If you are not already within the *Traces* Sub-menu, select *Traces* or press **F2** from the Main Menu.
2. Select *Peak/Avg* from the *Traces* Sub-Menu or press **F2**.
3. Select the *Clear Peak* icon from the *Peak/Avg* Sub-menu.
4. The peak trace will be cleared and begin building again with the data from the current real time trace. If the Sweep Count Indicator is displayed, the Peak Trace Sweep Count will be reset and begin incrementing again as new trace data is collected.

To Save Peak Trace Data:

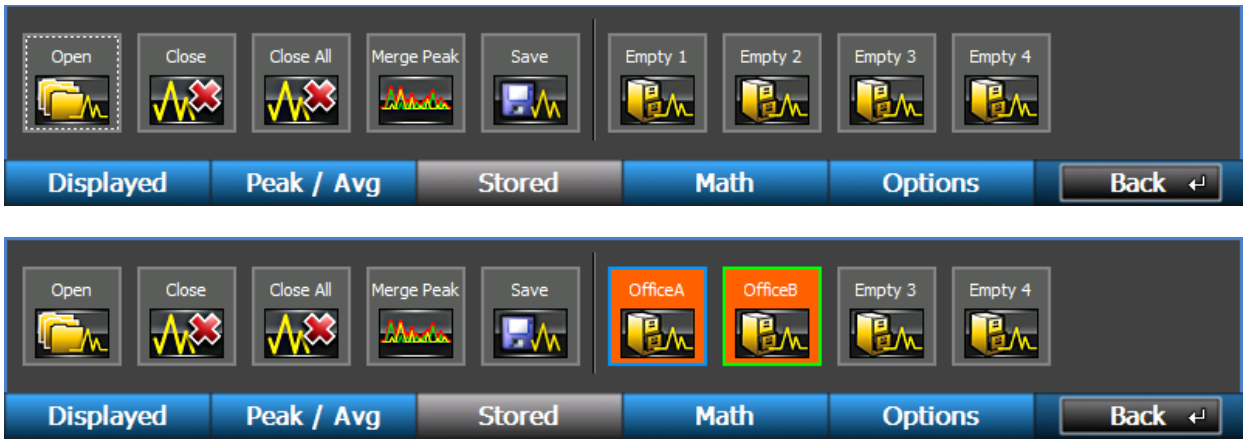
1. If you are not already within the *Traces* Sub-menu, select *Traces* or press **F2** from the Main Menu.

2. Select *Peak/Avg* from the *Traces* Sub-Menu or press **F2**.
3. Select the *Save Peak* icon from the *Peak/Avg* Sub-menu.
4. From the dialog box that appears select a place to save the trace and name the saved trace.

To Open or Close a Saved Trace:

Up to four saved traces can be opened on the OSCOR unit at any given time. In the *Traces*| *Stored* Sub-Menu, there are four icons labeled "Empty 1", "Empty 2", "Empty 3", and "Empty 4". These represent the four traces that can be opened. Each saved trace that is opened will be displayed in these icons. After four traces have been opened, a trace must be closed before any additional traces can be opened.

1. From the *Traces* Sub-menu, select *Stored* or press **F3**.
2. Select the *Open* icon or select one of the *Empty* icons.
3. From the dialog box that appears, navigate to any attached storage, such as a compact flash card or a USB thumb drive, select a saved peak trace, and choose **OK**.
4. The trace will be opened in the **Empty 1** space. The name of the trace will be displayed in the icon. The color of the icon's outline will indicate the color of the open trace in the spectrum display. The same color will also be used in the Sweep Count Indicator and Legend, if displayed. The trace can be turned off/on by toggling this icon in the Stored Sub-menu. The next saved trace opened will open in the **Empty 2** space and likewise, the next opened trace will open in the **Empty 3** space. Again, only four saved traces can be opened on the OSCOR unit at any given time. To open any additional traces, one of the opened traces must first be closed.



To turn off the display of the stored trace, simply tap the stored trace icon.

To close an opened trace, select the *Close* icon and then choose a trace to close.

Average Trace

The average trace is created by averaging a specified number of real time traces. An average trace can be very effective in reducing the noise floor, since the noise is averaged out, giving the user a better view of any signals that may be present.

An average trace can also be used to detect a snuggled bug. A snuggled bug is typically a narrow band RF transmitter tuned very close to the frequency of an existing wide band signal such as an FM radio station. By tuning the snuggled signal very close to the center frequency of the wide band ambient signal, the snuggled signal is essentially masked by the demodulation of the radio station signal. With the average trace, the wideband modulation of the radio station is “averaged” out so that the narrow band transmitter is easily seen.

CAUTION Using the average trace alone could cause certain types of signals to be missed. Signals such as spread spectrum or frequency hoppers will disappear into the noise floor in an average trace. Always use average trace in conjunction with both the peak trace and real time trace to analyze the spectrum.

To display an average trace:

1. From the Main Menu, select *Traces* or press **F2**.
2. From the *Traces* Sub-Menu, select *Peak/Avg* or press **F2**.
3. Select the *Average* icon. An average trace will be displayed.

Several other tasks related to the average trace can be performed from the *Traces* | *Peak/Avg* Sub-Menu.

Save Avg – Save the currently displayed trace to a USB thumb drive or compact flash card

Traces Averaged – adjust the number of real time traces included in the average

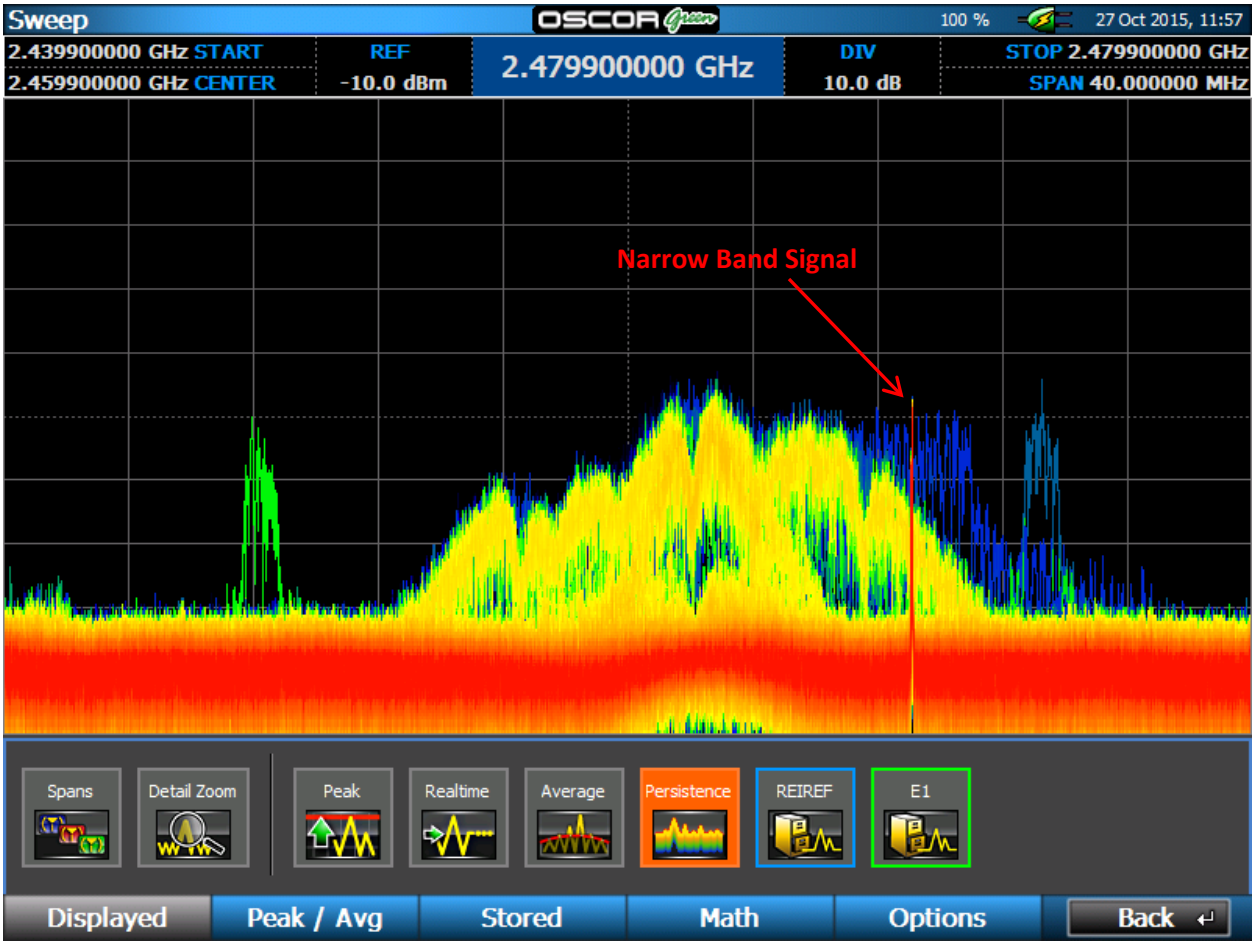
To open a previously saved average trace, follow the steps for opening a saved peak trace (see page 35). Only four saved traces (peak or average) can be open simultaneously.

Persistence View

The persistence view is available in Sweep Mode and displays the trace data from each sweep of the receiver using fading colors in order to indicate how frequently and recently each signal was encountered. Transient signals are displayed in darker colors (blues & greens) and fade quickly, whereas more permanent or persistent signals are displayed in brighter colors (reds and yellows). This enables the user to easily identify transmit signals even when surrounded by multiple transient signals or noise.

For example, the image below shows the persistence trace being used to display the Wi-Fi band. In the image, it is obvious that a narrow band signal is "hiding" within Wi-Fi traffic. With the real time trace or

peak trace views, this signal might be overlooked or obscured by the surrounding Wi-Fi traffic. However, using the Persistence Trace view, the narrow band signal stands out among the Wi-Fi signals.



To display the Persistence view

1. In Sweep Mode from the Main Menu, select *Traces* or press **F2**.
2. The Displayed Sub-Menu should be visible. If it is not, select *Displayed* or press **F1**.
3. From the Displayed Sub-Menu, select the *Persistence* icon. The Persistence view will be displayed.

Note: For optimal performance, it is recommended that the display of the Peak Trace and Realtime Trace be turned off when using Persistence View.

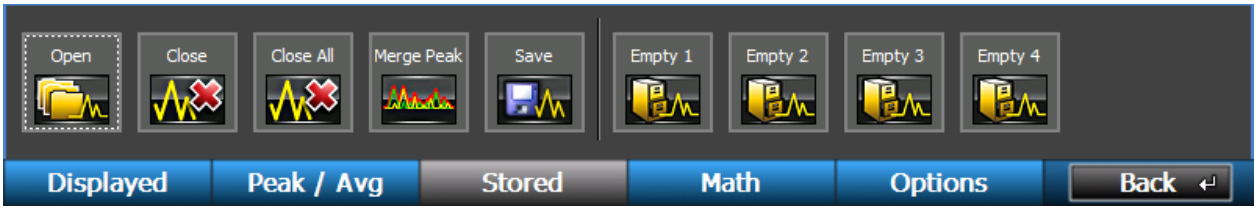
Merge Peak

The Merge Peak function creates a single, merged trace from two stored peak traces 'A' & 'B'. The resulting trace contains all the peaks from both 'A' & 'B' and can be saved as a new peak trace file using the *Save* icon in the *Traces* | *Stored* Sub-Menu.

Note: After performing the Merge Peak function, Trace 'A' will be closed and the resulting, merged trace will be opened in the same storage slot.

To merge two stored peak traces:

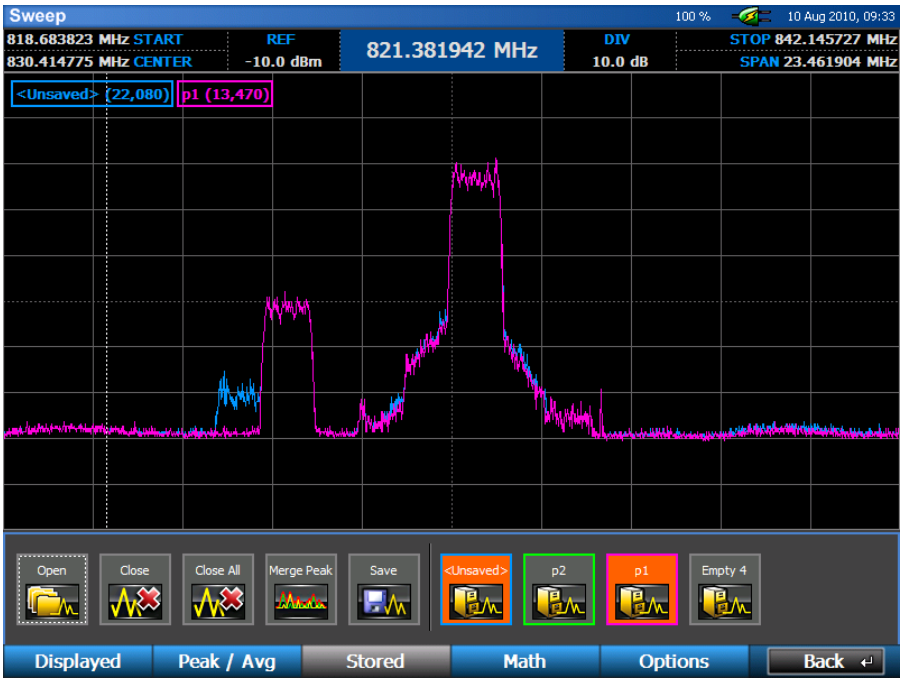
1. Select "Merge Peak" from the *Traces* | *Stored* Sub-Menu



2. Select the stored traces to be merged

After a few seconds the merged trace will be listed as "Unsaved". Use the *Save* icon found in the *Traces* | *Stored* Sub-Menu to save the newly merged trace.

If desired you can open and compare traces 'A' (labeled P1) and 'B' (labeled P2) to the merged trace to see the resulting merged peaks as shown below:



P1 and Merged Traces

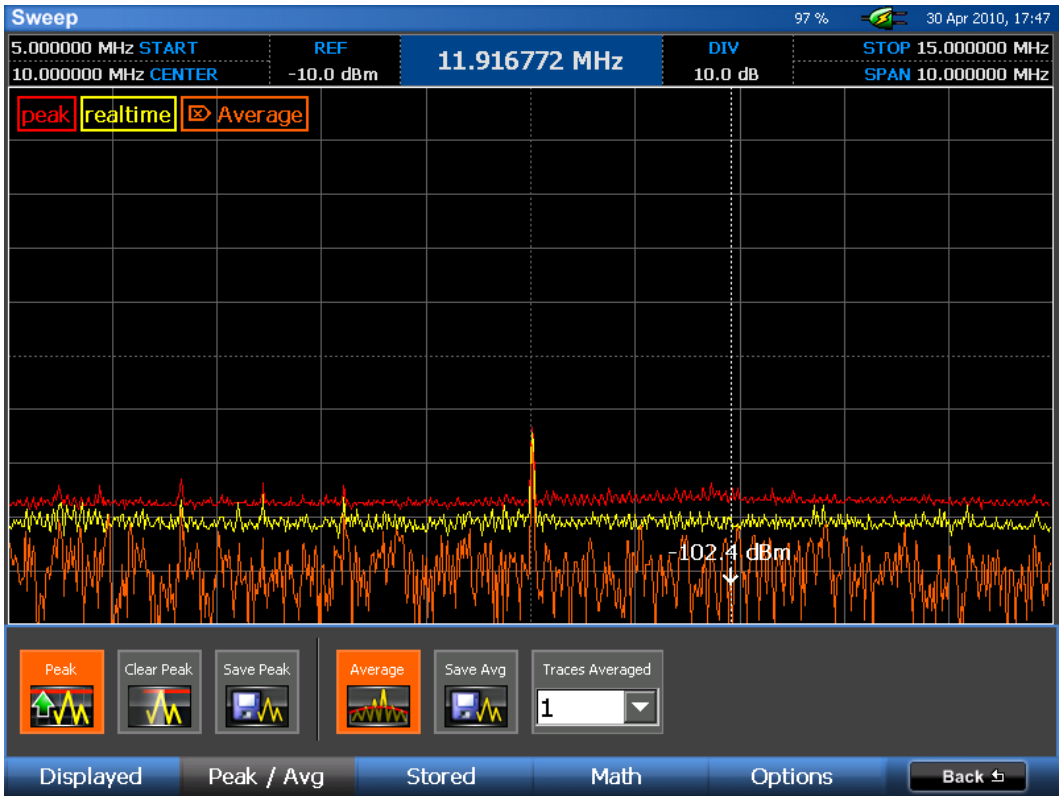
P2 and Merged Traces

A Note Regarding Noise Floor Levels

Peak Traces will tend to have a higher perceived noise floor, because the highest peak at each point along a trace is stored and anything else is ignored until an even higher peak is encountered. Real time

traces, even though they are meant to be a more instantaneous view of the spectrum, can also have a higher perceived noise floor because they are also constructed using peaks. When you are looking at a very narrow span, as long as you are not in Detail Zoom mode (see page 44), the tuner is able to sweep much faster than the display screen can refresh so that each display update may contain data from several sweeps – 150 sweeps or more at the narrowest span. (The sweep count indicator will display the number of sweeps contained within each spectral display update.) Each screen update will only contain peaks of all the sweeps that occurred between screen updates. As you expand the display and begin looking at a wider spectrum, fewer sweeps occur between each refresh of the display; however, in order to fit the entire spectrum on the display, each pixel will begin to represent a larger bandwidth – as much as 30 MHz at the maximum span on a 24 GHz model. All of the points within this bandwidth are peaked and only the highest peak is displayed. The combined effect of both of these phenomena cause the perceived noise floor of the real time trace to be higher, not as high as the peak trace, but still higher than the actual noise floor. A more accurate depiction of the noise floor level can be achieved through using the average trace, because each trace, rather than being peaked, is averaged. To see the actual noise floor, use the average trace, with *Traces Averaged* set to 1, and set the span to less than 10 MHz.

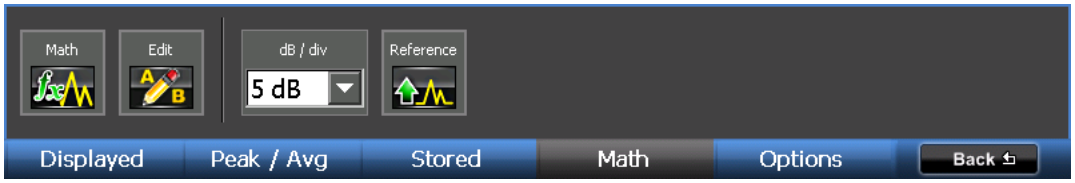
From the screenshot below, it is easy to see that the peak trace (in red) has the highest perceived noise floor, then the real time trace (in yellow), and finally the average trace (in orange) displays the actual noise floor.



Math Trace

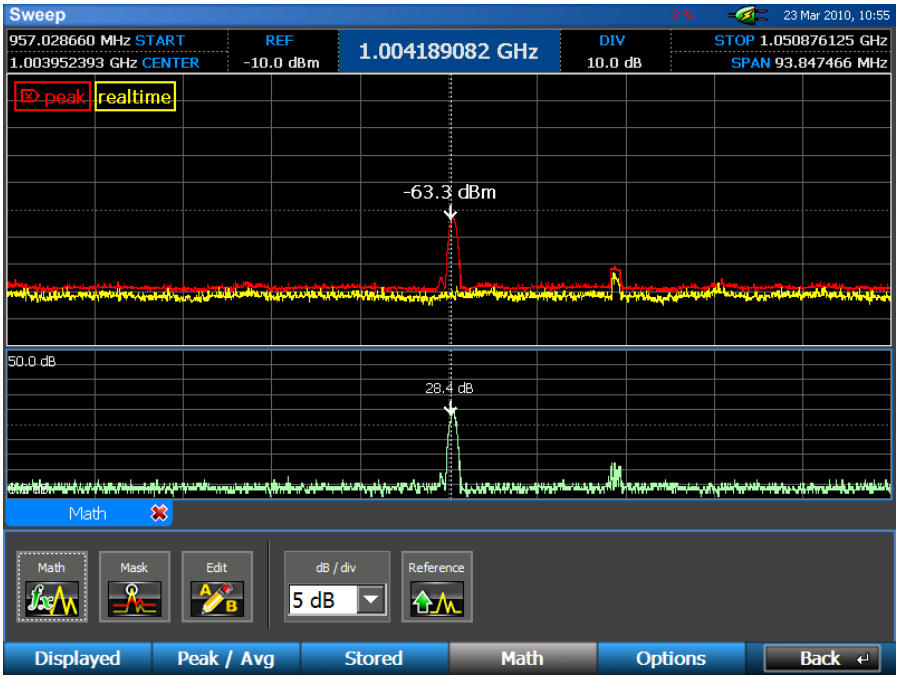
The OSCOR provides the ability to compare two different sets of trace data. Math traces can be generated from the real time trace, peak trace, average trace, or up to 4 saved traces if they are currently open on the OSCOR unit. The Math Trace allows a very quick view of the difference between the Frequency Spectrum of two different locations or the same location at two different times, and is a very reliable method for detecting sophisticated transmitters that are not continuous transmitters. This mode is useful to determine the location of a transmitter within an environment by comparing the RF spectrum of one room to another room.

Warning: It is important to understand that this function is not a true math A-B function. It only provides the difference spectrum for signals in Trace A that are larger than the corresponding frequency in Trace B. In other words, the math trace will not indicate signals in B that are larger than A. Therefore, to highlight all differences between the two signals, it is important to generate two math traces, swapping the order of the traces the second time.



To Display a Math Trace:

1. From the Main Menu, select *Traces or press* **F2**.
2. From the *Traces* Sub-Menu, select *Math or press* **F4**.
3. Select the *Math* icon. *Note: If a math trace has already been set up once during your current session, you will need to use the Edit* icon *to change the math trace.*
4. From the drop-down menus in the Edit Math Trace dialog box, select traces for *Trace A* and *Trace B*and select *OK*. The math trace will open in a tabbed window below the spectral display. The example below shows a comparison between the peak trace and real time trace.



Several other tasks related to the math trace can be performed from the Traces|Math Sub-Menu.

- *Math* – Once a math trace has been set up, pressing the *Math* icon again will hide the math trace. Each subsequent press of the *Math* icon will toggle the display of the math trace. Only one math trace can be displayed at a time.
- Mask – Compares the realtime trace to a stored mask trace and adds a signal to the signal list when the difference exceeds a user defined threshold. This comparison is done on a sweep by sweep basis. If the real time signal remains above the threshold then there is only one event added to the list. If the realtime signal drops below the threshold and then exceeds the threshold again, another event will be added to the signal list. The signal list table includes frequency, power, bandwidth, timestamp, last seen timestamp and count information.

Note: While using the Mask function, you may notice some signals seem to automatically be removed from the list. Some types of signals, such as frequency hoppers or FM transmitters may initially appear as several distinct, closely spaced signals. Overtime, as the envelope of this signal begins to fill in with peaks, the Mask function will automatically group these previously recognized narrow band signals into one signal with a larger bandwidth.

Mask Example: Detecting the presence of a cell phone call

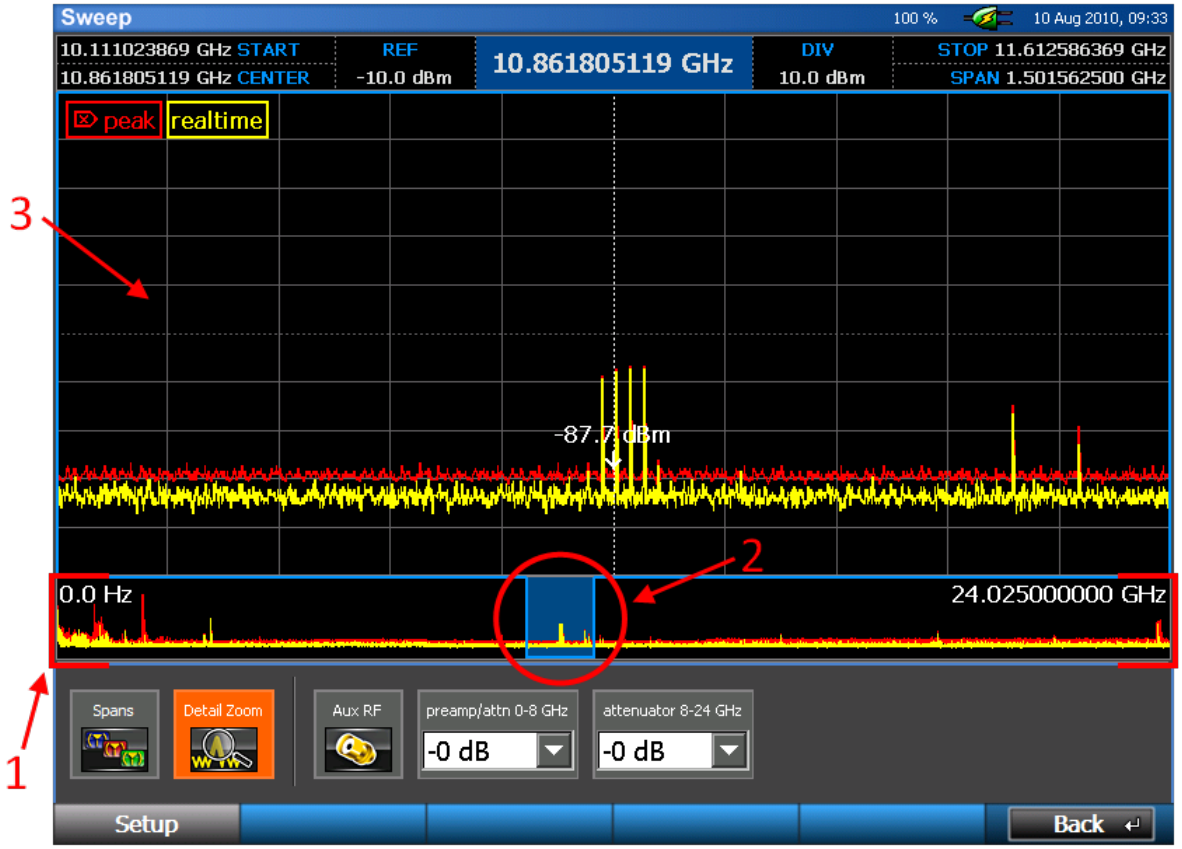
- *Edit* – Once a math trace has been set up, use the *Edit* icon to change what traces are used in the Math Trace.
- *dB / div* – The dB/div drop down box allows you to change the scale of the math trace graph. By default this is set to 5 dB per division.
- *Reference* – use the *Reference* Icon to change the reference level of the bottom of the math trace graph. The reference level can be adjusted from -40 dB to 100 dB. To enter negative reference values, select *+/-* on the virtual keypad or press the **+/-** key *after* entering the numeric value.

Detail Zoom

Up to this point, all methods described for navigating around the spectrum, i.e. narrowing or expanding the span, changing start and stop frequencies, panning across the spectrum, etc…, have involved changing the range the tuner is actually sweeping. What if you are interested in continuing to sweep the full tuner range with the OSCOR collecting peak data for the full range, but you want to look at just a specific portion of the spectrum in more detail? In this situation, you would use the Detail Zoom feature on the OSCOR. To enable Detail Zoom on the OSCOR:

1. Set the range that you want the tuner to sweep (see page 30).
2. From the Main Menu, select *Setup* or press **F1**.
3. Select the *Detail Zoom* icon.

Detail Zoom Screen Elements



1. **Spectral Thumbnail** – The spectral thumbnail shows the range that the tuner is sweeping. Start and stop frequencies for the tuner are displayed on the left and right sides of the spectral thumbnail.

2. **Zoom Region** – shows the portion of the tuner range that is displayed in the detail zoom window.

3. **Detail Zoom Window** – When zoomed in on a portion of the tuner range, this window is where you will view the zoomed portion of the spectrum.

Navigating within the Detail Zoom Window

When Detail Zoom is on, all of the spectral parameters at the top of the screen refer to the Detail Zoom Window, not the range currently being swept by the tuner or the spectral thumbnail. Also, when detail zoom is on, any changes made to the spectral parameters or any of the methods described previously for navigating the spectrum will change only the detail zoom window; the tuner continues to sweep the same range that was set when Detail Zoom was turned on. With Detail Zoom on, there is one additional way to navigate the spectrum:

- Click & Drag – Thumbnail Pan: if the detail zoom window is set to a narrower span than the spectral thumbnail (or tuner range), you can pan the current spectrum by *clicking* within the zoom region (or highlighted portion of the spectral thumbnail) with the stylus or your finger and *dragging* the highlighted portion to the left or right.

Setting Up the Tuner Range for Detail Zoom

The tuner range must be set up before Detail Zoom is entered. If you wish to change the tuner range once detail zoom has been turned on, you must first disable Detail Zoom (select the *Detail Zoom* icon within the *Setup* Sub-Menu so that it is not highlighted) and then adjust the tuner range.

WARNING: *When Detail Zoom is turned off, the tuner range will be adjusted to the same range as the detail zoom window. If you are collecting peak data for a specific tuner range, be sure to set the detail zoom window to that range before switching detail zoom off.*

By default, the tuner range in Detail Zoom mode is established by how the tuner is setup when Detail Zoom is entered. It is possible to have the tuner always switch to a specific preset when Detail Zoom is entered:

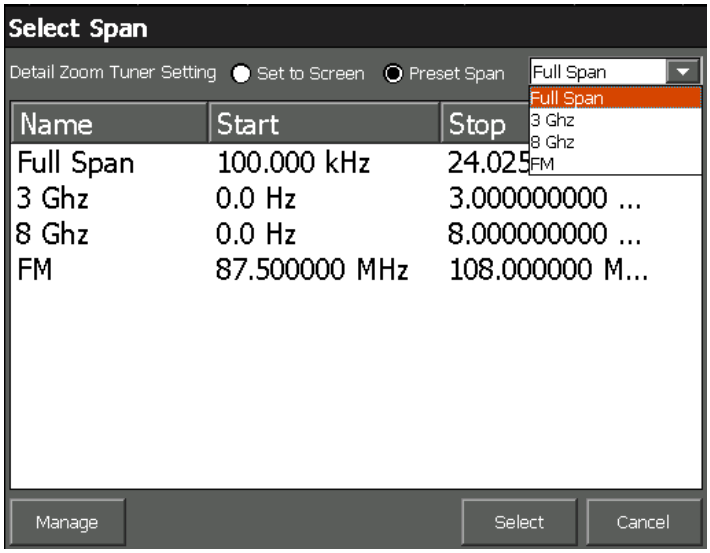
1. From the Main Menu, select *Setup* or press **F1**.

2. Select the *Spans* icon.

3. At the top of the dialog box, switch the Detail Zoom Tuner Setting from "*Set to Screen"* to *"Preset Span"* by selecting *Preset Span*.

4. From the drop down box next to *Preset Span*, select a span.

To create a new preset span for the detail zoom tuner setting, you must first create a new custom tuner span (see page 25).

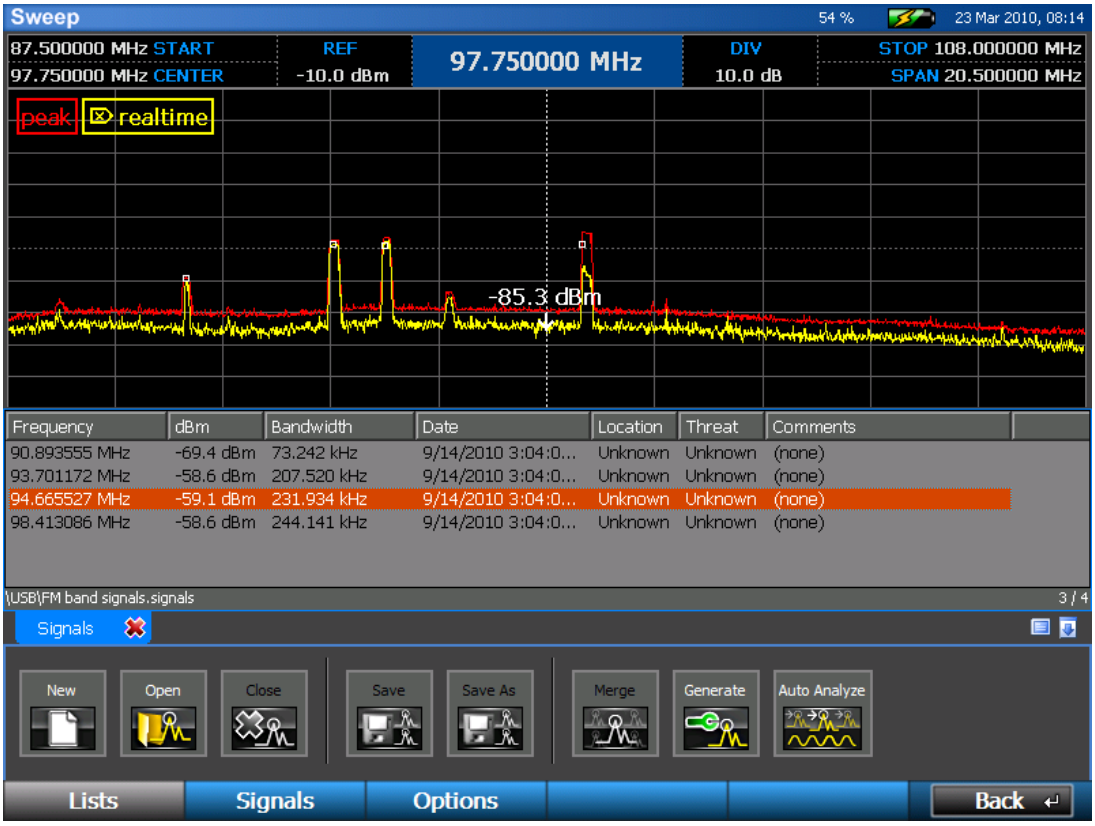


Note: Detail Zoom can also be accessed from the *Traces* | *Displayed* Sub-Menu.

Signals

Signal Lists

A signal list allows you to store and recall frequencies of interest along with additional information such as signal amplitude, bandwidth, threat level, location, and any other comments which may be important. With the OSCOR, you have the capability to automatically generate signal lists, merge signals from multiple databases, add or delete signals from an existing database, or edit the information for any given signal – all on the OSCOR unit itself.



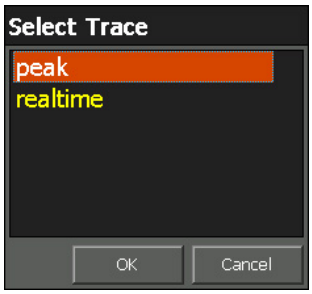
The signal list parameters that are automatically identified by this functionality include:

- Frequency –Peak of the signal within the measured bandwidth window
- dBm – Signal Level in dBm
- Bandwidth – The measured Bandwidth of the signal between the signal threshold levels (this bandwidth may vary depending on the modulation and detected signal characteristics)
- Date – The date and time the signal was identified in the signal list. *Note: This is not the actual time that a signal was detected within a peak trace.*
- Last Seen, Count – these fields are automatically populated by the *Mask* function (see page 42).
- Location, Threat, Comments – these are fields that can be edited by the user for later analysis.

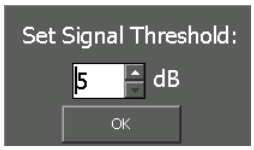
Generating and Saving a Signal List

To generate a signal list:

1. From the Main Menu, select *Signals* or press **F3**.
2. The Lists Sub-Menu should be visible. If it is not, select *Lists* or press **F1**.
3. From the Lists Sub-Menu, select the *Generate* icon.
4. A dialog box will appear asking you to select from any currently displayed traces. Any signals on the trace that you select with an amplitude greater than the set threshold will be added to the generated signal list. Select the desired trace and press OK.



5. A menu will appear to specify the signal level threshold. The OSCOR unit evaluates the noise floor and identifies all of the signals that exceed the noise floor by this threshold amount. Set the desired threshold level and press OK.



6. The generated signal list will appear in a tabbed window below the spectral display. Each signal generated will be tagged with a small square marker in the spectral display.
7. From the Lists Sub-Menu, select the *Save* icon. From the Save Dialog Box, select a location and name for the saved signal list. Select *OK* or press **F5**.

Signal Lists are saved in a comma-separated values, or CSV, file format so that they are easily exported and read by spreadsheet programs, such as Microsoft Excel, or text editors, such as Notepad. The file extension used for a signal list file is ".signals"; however, the underlying format is CSV. To open a signal list in Microsoft Excel, or other spreadsheet program, and maintain the tabular properties of the signal list it may be necessary to specify how the file is delimited when opening the file. Consult the manual for your particular spreadsheet program for details. Caution: Editing a signal list file with another program could affect reopening the file on the OSCOR unit.

Note: Signal Lists are only generated from the viewed spectrum. To generate a signal list based on the entire 24 GHz spectrum (or 8 GHz for 8 GHz models) ensure that the entire spectrum is shown by

pressing **SHIFT** + **EXPAND**. If Detail Zoom is on, then the signal list will be generated from the spectrum shown in the spectral thumbnail.

Opening or Closing a Signal List

1. If you are not already in the Signals|Lists Sub-Menu, from the Main Menu select *Signals*|*Lists.*
2. From the Lists Sub-Menu, select the *Open* icon. The open dialog box will appear.
3. After navigating to the media where your signal list is located, select your previously saved signal list and select *OK* or press **F5**.
4. To close any open signal list, select the *Close* icon from the *Signals* | *Lists* Sub-Menu or select the red 'x' on the tabbed signal list window. Both the displayed signal list and the markers displayed in the spectral graph will disappear.

Note: A signal list can be open at the same time as a Sweep Mode RSSI locator window, a live raster waterfall, or a math trace. If more than one of these items is open, these windows will be tabbed. Select a tab to display the respective window.

Merging Signal Lists

With the OSCOR, you are able to merge multiple signal lists in the unit itself. However, you must be careful with this function because it is relatively easy to corrupt a signal list with duplicates of the same signals.

1. Open one of the signal lists that you would like to merge.
2. If you are not already in the Signals | Lists Sub-Menu, from the Main Menu select *Signals* | *Lists*.
3. From the Lists Sub-Menu, select the *Merge* icon. The open dialog box will appear.
4. From the open dialog box, choose another signal list that you would like to merge and select *OK* or press **F5**. This signal list will now open and will be merged with the signal list that was already open on the unit.
5. You can continue merging additional signal lists by repeating steps 3 and 4. Be sure to select the *Merge* icon and not the *Open* icon.
6. When you are finished working with the merged signal list, be sure to save it for future reference.

Adding or Removing Signals from Signal Lists

Signals can be added to or removed from any open signal list. If no signal list is currently open and you add a signal, a new list is created with the added signal. This list must be saved before it is closed or before you open another list, if you want to be able to recall it later.

1. Position the cursor on the frequency of the signal that you would like to add to the list. When adding signals, the OSCOR will search for the largest peak in the area immediately surrounding the cursor. For increased accuracy narrow in on the cursor position before adding the signal.
2. From the Main Menu, select *Signals* or press **F3**.
3. From the Signals Sub-Menu, select *Signals* or press **F2**.
4. Select the *Add* icon. If a signal list is already open, the signal will be added to this list. If no signal list is open, a new list will be created with this signal added.
5. Continue adding signals by repeating these steps.
6. To remove a signal, select the signal you wish delete from the displayed signal list with the stylus.
7. From the Signal Sub-Menu, select the *Remove* icon. The selected signal will be removed.
8. When you are finished editing your signal list, be sure to save it, if you want to be able to recall it later.

Editing Signals

Additional information can be stored with each signal in your signal list, such as whether the signal is known or a possible threat, a location, and any comments that you want to add. The frequency, amplitude and bandwidth values can also be tweaked. To edit a signal:

1. Select the signal in the signal list with the stylus or your finger.
2. If you are not already in the Signals | Signals Sub-Menu, from the Main Menu select *Signals* | *Signals*.
3. From the Signals Sub-Menu, select the *Edit* icon.
4. The Edit Signal Dialog Box will appear.
5. Edit information for the signal and press *OK*.

It is also possible to edit a signal list without switching to the Signals Sub-Menu:

1. Tap the signal list with the stylus or your finger to highlight the signal you want to edit.

2. Press the OK button.

3. Select “Edit Signal” from the context menu that appears. Edit information for the signal and press *OK*.

Hiding/Showing the Signal List and Markers

To hide the signal list and/or the markers which are displayed by default on the spectral graph when a signal list is generated:

1. If you are not already in the Signals Sub-Menu, from the Main Menu select *Signals* or press **F3**.

2. From the Signals Sub-Menu, select *Options* or press **F3**.

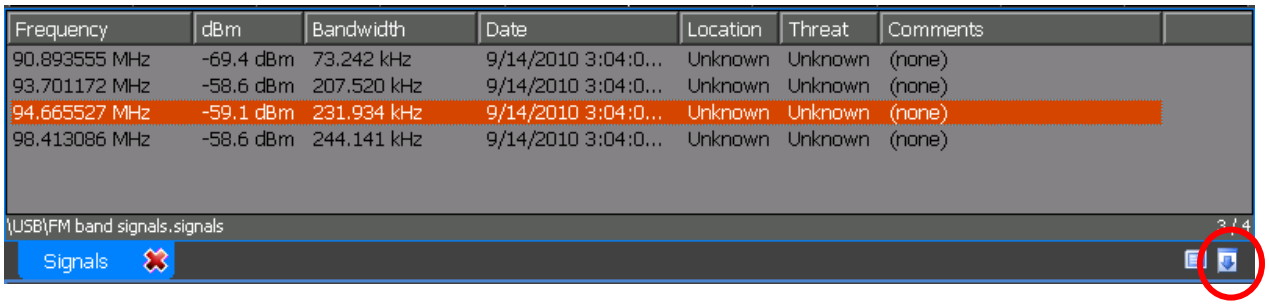
3. From the Options Sub-Menu, select the *Show List* icon. The Signal List will be hidden. Select the *Show List* icon again to display the list.

4. From the Options Sub-Menu, select the *Markers* icon. The Signal Markers on the graph will be hidden. Select the *Markers* icon again to display the markers.

Notes

- Hiding the Signal List does not close the signal list. A signal list can be hidden without being saved. Ensure any signal list that is hidden is saved before shutting down the unit or the data from the signal list could be lost.

- The tab pane can also be collapsed to hide the signal list by tapping the downward arrow in the lower right corner. To expand the tab pane select the arrow again.


Frequency
dBm
Bandwidth
Date
Location
Threat
Comments
90.893555 MHz -69.4 dBm 73.242 kHz 9/14/2010 3:04:0... Unknown Unknown (none)
93.701172 MHz -58.6 dBm 207.520 kHz 9/14/2010 3:04:0... Unknown Unknown (none)
94.665527 MHz -59.1 dBm 231.934 kHz 9/14/2010 3:04:0... Unknown Unknown (none)
98.413086 MHz -58.6 dBm 244.141 kHz 9/14/2010 3:04:0... Unknown Unknown (none)
\USB\FM band signals.signals
Signals

Traversing a Signal List

Controls exist for easily moving the cursor from one signal to the next within a signal list. After generating a signal list:

1. If you are not already in the Signals Sub-Menu, from the Main Menu select *Signals* or press **F3**.

2. From the Signals Sub-Menu, select *Signals* or press **F2**.

3. From the Signals Sub-Menu, select the *Closest* icon. If the cursor is not already positioned on a signal marker it will move to the closest one. If the Signal List is displayed, the signal will be highlighted in the list.

4. From the Signals Sub-Menu, select the *Next* icon. The cursor will move to the signal in the Signal List with the next highest frequency.

5. From the Signals Sub-Menu, select the *Previous* icon. The cursor will move to the signal in the Signal List with the next lowest frequency.

To move the cursor directly to a signal in a displayed signal list:

1. Double tap the signal in the signal list with the stylus.

or

1. Tap the signal list with the stylus or your finger to highlight the signal you want to edit.
2. Press the OK button.
3. Select “Go To Signal” from the context menu that appears.

Notes:

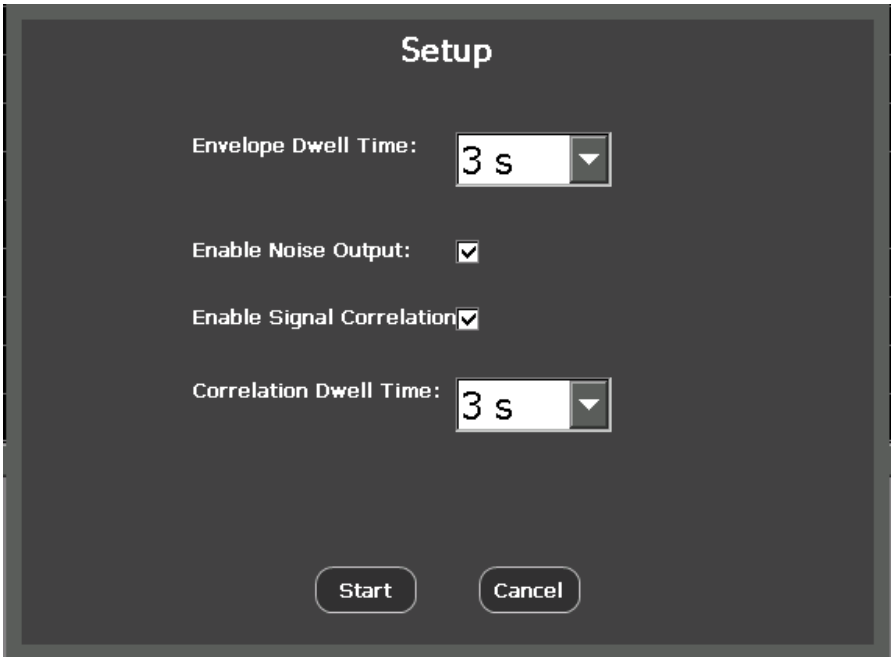
- The info bar at the bottom of the signal list displays the file path for the signal list or it will indicate “Not saved” if the currently displayed signal list is not saved.
- The total number of signals in the list is displayed on the right side of the info bar. If one of the signals in the list is highlighted, the order number of the highlighted signal will also be displayed.
- By default the signal list is sorted by frequency. To sort a signal list by another parameter, tap one of the column headings at the top of the signal list.

Auto Analyze

After a signal list has been generated, the Auto Analyze function will automatically step through each signal in the signal list fine tuning main carrier frequencies, bandwidth measurements, and determining whether or not the signal correlates with room audio. Frequency and bandwidth determinations that are made during signal list generation in Sweep Mode are subject to the resolution bandwidth limitations found in Sweep Mode. The Auto Analyze function does a single frequency signal analysis on each signal in a signal list and will make small adjustments to frequency and bandwidth values to more accurately reflect the true main carrier frequency and bandwidth of the signal. For any analog signals found in the list, the Auto Analyze function will make a determination of whether or not the demodulated audio from the signal correlates with room audio. If it does, it will add this information to the Threat column in the signal list. A manual correlation function is also available on the OSCOR unit (see page 74).

To Auto Analyze a Signal List:

1. Open an existing signal list (see page 49) or generate a signal list (see page 48).
2. If you are not already in the Signals Sub-Menu, from the Main Menu select *Signals* or press **F3**.
3. The Lists Sub-Menu should be visible. If it is not, select *Lists* or press **F1**.
4. From the Lists Sub-Menu, select the *Auto Analyze* icon. The Auto Analyze Setup dialog box will appear.



5. The following options are available from the Setup dialog:
    a. Envelope Dwell Time – this configures the amount of time that the Auto Analyze function will dwell on each signal to make bandwidth determinations. The following options are available from the drop down box: 1 second, 3 seconds, and 5 seconds. The

longer the dwell time is, the more accurate the bandwidth value will be, however, the overall time for the Auto Analyze process will be longer. The default value for Envelope Dwell Time is 3 seconds.

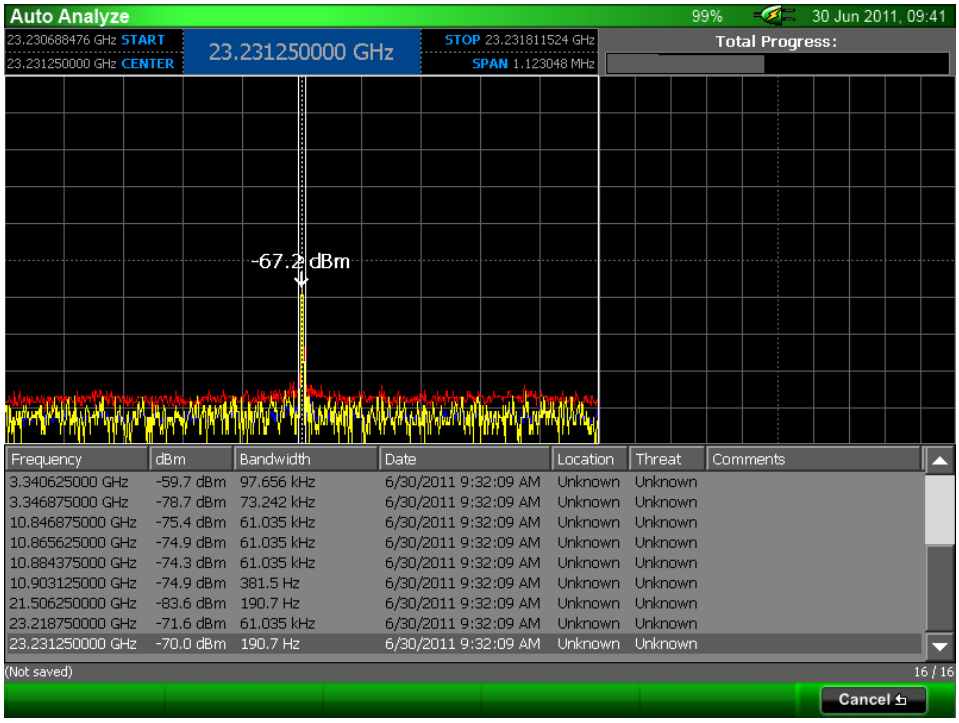
b. Enable Noise Output – selecting this option will enable the white noise generator and unmute the audio. The white noise generated by the OSCOR unit will aid in correlation of analog signals and in the bandwidth measurement of FM signals.

c. Enable Signal Correlation – if this option is selected the OSCOR unit will attempt to demodulate each signal and determine whether the demodulated audio correlates with room audio.

d. Correlation Dwell Time – this configures the amount of time that the Auto Analyze function will dwell on each signal to make correlation determinations. The following options are available from the drop down box: 1 second, 3 seconds, and 5 seconds. The longer the dwell time is, the more accurate the correlation determination will be, however, the overall time for the Auto Analyze process will be longer. The default value for Correlation Dwell Time is 3 seconds.

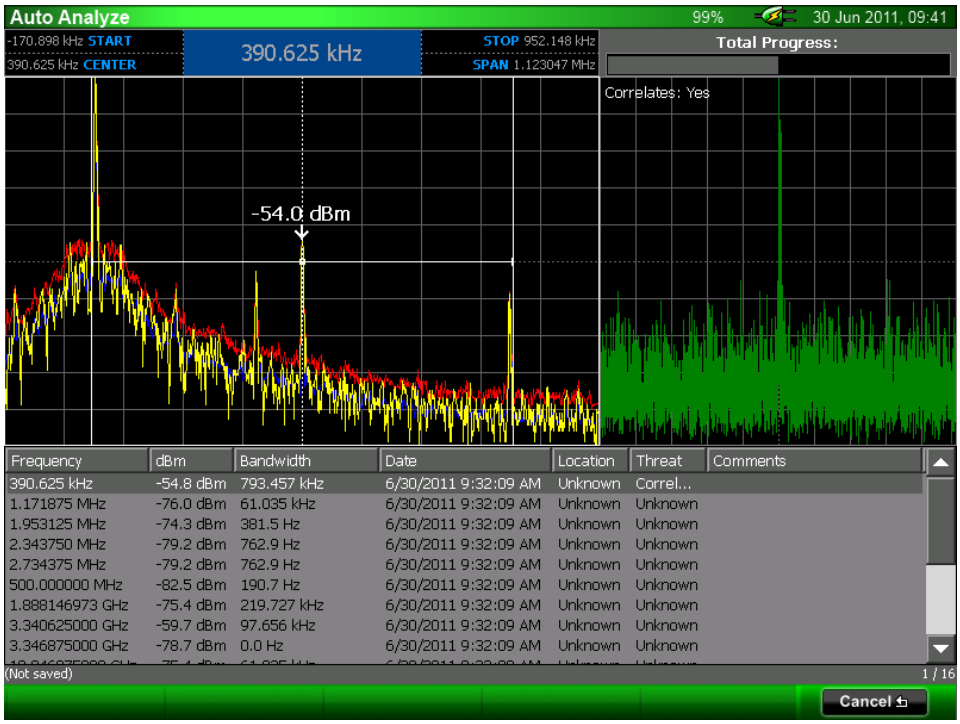
6. After configuring the Auto Analyze setup, Select *Start* to begin the Auto Analyze process or select *Cancel* to disregard the setup and return to the previous screen.

The Auto Analyze function first steps through each signal in the signal list analyzing the Main Carrier Frequency and the Bandwidth of each signal.


Auto Analyze
99%
30 Jun 2011, 09:41
23.230688476 GHz START
23.231250000 GHz CENTER
23.231250000 GHz
STOP 23.231811524 GHz
SPAN 1.123048 MHz
Total Progress:
-67.2 dBm
Frequency dBm Bandwidth Date Location Threat Comments
3.340625000 GHz -59.7 dBm 97.656 kHz 6/30/2011 9:32:09 AM Unknown Unknown
3.346875000 GHz -78.7 dBm 73.242 kHz 6/30/2011 9:32:09 AM Unknown Unknown
10.846875000 GHz -75.4 dBm 61.035 kHz 6/30/2011 9:32:09 AM Unknown Unknown
10.865625000 GHz -74.9 dBm 61.035 kHz 6/30/2011 9:32:09 AM Unknown Unknown
10.884375000 GHz -74.3 dBm 61.035 kHz 6/30/2011 9:32:09 AM Unknown Unknown
10.903125000 GHz -74.9 dBm 381.5 Hz 6/30/2011 9:32:09 AM Unknown Unknown
21.506250000 GHz -83.6 dBm 190.7 Hz 6/30/2011 9:32:09 AM Unknown Unknown
23.218750000 GHz -71.6 dBm 61.035 kHz 6/30/2011 9:32:09 AM Unknown Unknown
23.231250000 GHz -70.0 dBm 190.7 Hz 6/30/2011 9:32:09 AM Unknown Unknown
(Not saved)
16 / 16
Cancel

A progress bar at the top right of the screen gives a visual indication of the Auto Analyze progress. The top left of the screen features a spectral representation of each signal as Auto Analyze progresses through the signal list. The signal list is displayed across the bottom of the screen.

If you chose to enable Signal Correlation when setting up Auto Analyze, the Auto Analyze function will step through the signal list a second time to make a determination of whether or not the signal correlates with room audio.


Auto Analyze
99%
30 Jun 2011, 09:41
-170.898 kHz START
390.625 kHz CENTER
390.625 kHz
STOP 952.148 kHz
SPAN 1.123047 MHz
Total Progress:
Correlates: Yes
-54.0 dBm
Frequency dBm Bandwidth Date Location Threat Comments
390.625 kHz -54.8 dBm 793.457 kHz 6/30/2011 9:32:09 AM Unknown Correl...
1.171875 MHz -76.0 dBm 61.035 kHz 6/30/2011 9:32:09 AM Unknown Unknown
1.953125 MHz -74.3 dBm 381.5 Hz 6/30/2011 9:32:09 AM Unknown Unknown
2.343750 MHz -79.2 dBm 762.9 Hz 6/30/2011 9:32:09 AM Unknown Unknown
2.734375 MHz -79.2 dBm 762.9 Hz 6/30/2011 9:32:09 AM Unknown Unknown
500.000000 MHz -82.5 dBm 190.7 Hz 6/30/2011 9:32:09 AM Unknown Unknown
1.888146973 GHz -75.4 dBm 219.727 kHz 6/30/2011 9:32:09 AM Unknown Unknown
3.340625000 GHz -59.7 dBm 97.656 kHz 6/30/2011 9:32:09 AM Unknown Unknown
3.346875000 GHz -78.7 dBm 0.0 Hz 6/30/2011 9:32:09 AM Unknown Unknown
(Not saved)
1 / 16
Cancel

During this 2nd part of the process, a correlation graph will be displayed at the top right corner of the screen. If a signal does correlate with room audio, then the text “Correlates” is added to the Threat field for that signal in the signal list.

After using the Auto Analyze feature, always save the open signal list (see page 48) to ensure that any changes are not lost.

Note: The Auto Analyze function is also available in Analyze Mode from the Signals | Lists Sub-Menu.

Live Raster Waterfall

The Live Raster feature on the OSCOR captures a series of traces and displays them in a waterfall format. This is a quick way to observe the RF spectrum over a period of time and easily identify intermittent transmissions such as burst transmitters.

Opening, Clearing, and Closing a Live Raster Waterfall

1. From the Main Menu, select *Waterfall* or press **F4**.
2. If the Live Raster Sub-Menu is not already displayed, select *Live Raster* or press **F1**.
3. From the Live Raster Sub-Menu, select the *Show* icon. A Live Raster Waterfall window will be displayed and you will begin to see traces displayed as they are captured in a waterfall format.
4. To clear the waterfall display, from the Live Raster Sub-Menu, select the *Clear* icon. The waterfall data will be erased and the OSCOR unit will begin collecting traces again for a new waterfall display.
5. Once you have collected more than one screen full of data, use the scroll bar to see data off screen.
6. To close the Live Raster Waterfall data, select the *Show* icon from the Live Raster Sub-Menu or click the red 'x' on the tabbed window. The Live Raster Waterfall window will be hidden and data collection will be paused until the waterfall window is displayed again.

Notes

- The span and bandwidth of the spectral display can be changed while viewing a Live Raster Waterfall. However, whenever the spectral display is changed, the waterfall data will be cleared and a new waterfall will begin, unless Detail Zoom (see page 44) is turned on.
- The speed with which the Live Raster Waterfall data is captured and displayed will vary depending on the span of the RF spectrum; the narrower the span, the more quickly the data will be captured and displayed.
- Once the size of the Live Raster Waterfall has exceeded the memory buffer size, older traces will be discarded for each new trace added.
- If the realtime trace is not displayed, turning on the Live Raster Waterfall will also automatically turn on the realtime trace.

Viewing a Live Raster Waterfall Full Screen

The waterfall display from a Live Raster Waterfall can be viewed full screen.

1. While the Live Raster Waterfall is displayed and collecting date, select the *Full Screen* icon from the Live Raster Sub-Menu.
2. To close the full screen waterfall display and return to normal viewing, select *Close* or press **F6**.

Saving a Live Raster Waterfall

The waterfall display from a Live Raster Waterfall can be saved as a .png file for inserting into reports.

1. While the Live Raster Waterfall is displayed and collecting data, select the *Save* icon from the Live Raster Sub-Menu.
2. In the dialog box that appears, select a location (either a USB flash drive or compact flash card) and type a file name for the stored .png file. Select *OK* or press **F5**.

Notes

- The Live Raster Waterfall cannot be saved while viewing full screen; you must return to normal viewing in order to have access to the *Save* icon.

Opening a Saved Live Raster Waterfall

Previously saved Live Raster Waterfalls can be opened on the OSCOR unit for review.

3. From the Main Menu, select *Waterfall* or press **F4**.

4. If the Live Raster Sub-Menu is not already displayed, select *Live Raster* or press **F1**.

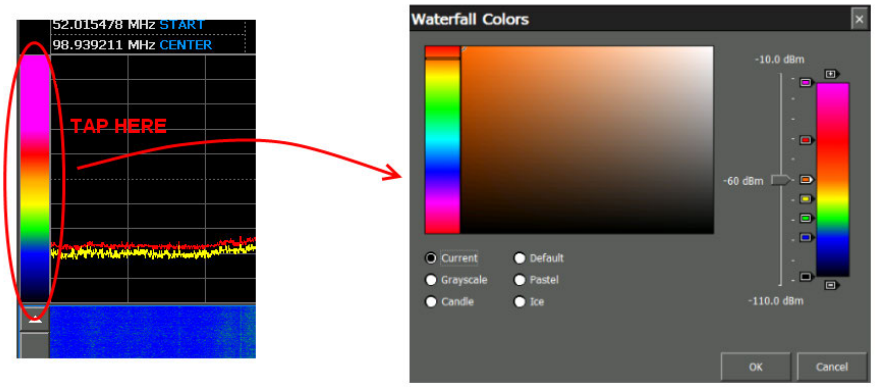
5. From the Live Raster Sub-Menu, select the *Open* icon.

6. From the dialog box that appears, navigate to any attached storage, such as a compact flash card or a USB thumb drive, select a saved peak trace, and choose *OK* or press **F5**. It may be necessary to change the file type (either .png or .bmp) in the dialog box to view previously stored waterfalls.

Modifying the Waterfall Color Gradient

The color gradient used for the Live Raster Waterfall can be customized by selecting colors for key amplitude levels.

1. Tap the color gradient shown at the top left hand side of the Live Raster Waterfall screen. The Waterfall Colors dialog box will appear. On the left side of the dialog box are two color controls for selecting colors. The slider to the far left is used to select a hue. The color field to the right of the hue slider is for adjusting the saturation and brightness of the selected hue. On the right side of the dialog box is a gradient editor for mapping specific colors to key amplitude levels of the waterfall color gradient.



2. To remove existing colors from the current color gradient, highlight the corresponding color marker from the gradient editor on the right side of the dialog box by selecting it with the stylus, then select the "-" marker at the bottom of the control.

3. To add a color to the color gradient, select the "+" marker at the top of the gradient editor on the right side of the dialog box. This will place a new color marker at the center of the gradient editor. Drag the new color marker up or down the gradient editor to modify the dBm value represented by the color. Edit the color of the marker by using the color controls on the left side of the dialog box.

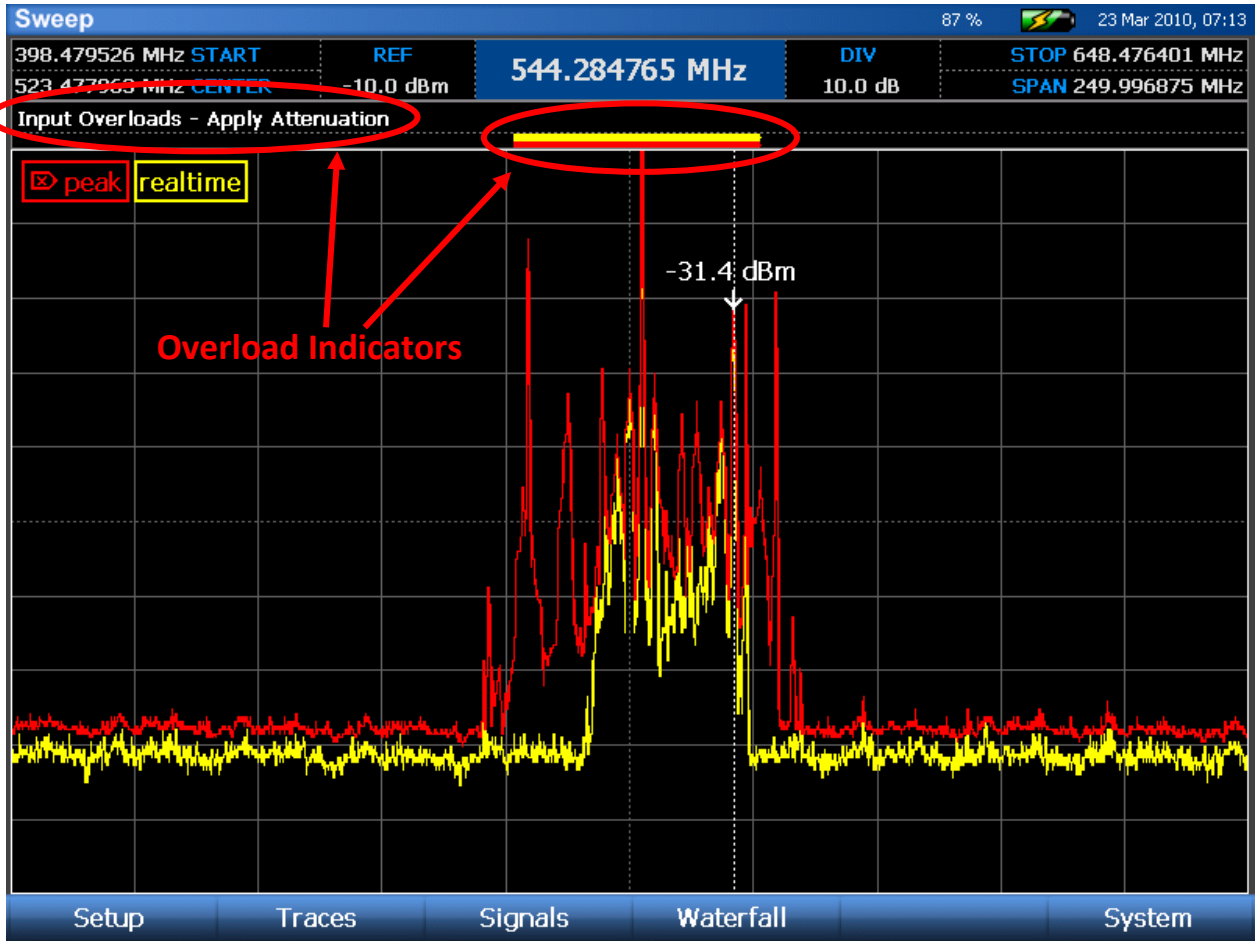
4. To edit an existing color in the color gradient, highlight the corresponding color marker on the gradient editor with the stylus. Drag the color marker up or down the gradient editor to modify the dBm value represented by the color. To edit the color of the selected marker, use the color controls on the left side of the dialog box.

5. To return to the default color gradient, select *Default* from the list of preset gradients on the left side of the dialog box.

6. After all changes have been made, select *OK* to enable changes.

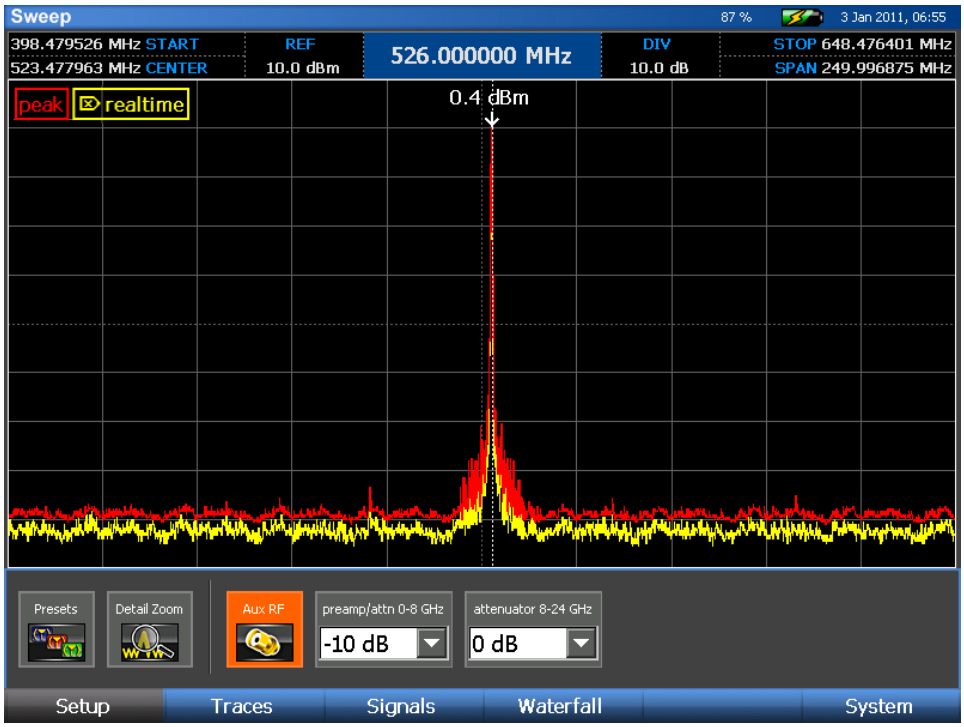
Receiver Overload – Sweep Mode

Due to the nature of digital receivers, very strong signals can have an overloading effect on the receiver circuitry, resulting in intermodulation distortion and/or large spurs appearing at aliased frequencies. To assist in these situations, the OSCOR is equipped with overload indicators to alert the user that an overload is occurring.

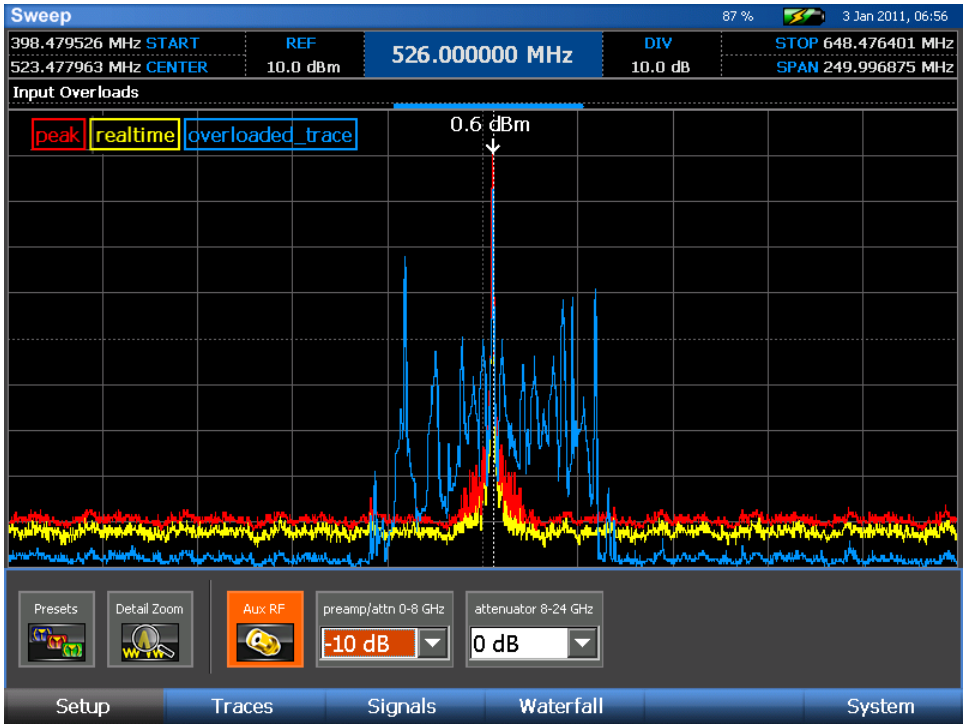


In the screenshot above, a very strong signal at 525 MHz is causing an overload situation. As a result, it appears that there are many signals in the area around this frequency. The red & yellow bars in the row above the spectrum are indications that receiver overload is occurring in both the peak (red) trace and the realtime (yellow) trace. Also, the text “Input Overloads” appears above the spectrum with the words “Apply Attenuation” flashing as an additional warning.

To correct the receiver overload, apply the smallest amount of input attenuation (see page 27) that prevents the overload condition.



The screenshot above shows the same signal, but with 10dB of input attenuation applied. The overload indicators have disappeared as well as the false spurs.



Overload information is stored when peak traces are saved. The screen shot above shows a blue bar above the spectrum to indicate that the stored trace (which is displayed in blue) has an overload condition.

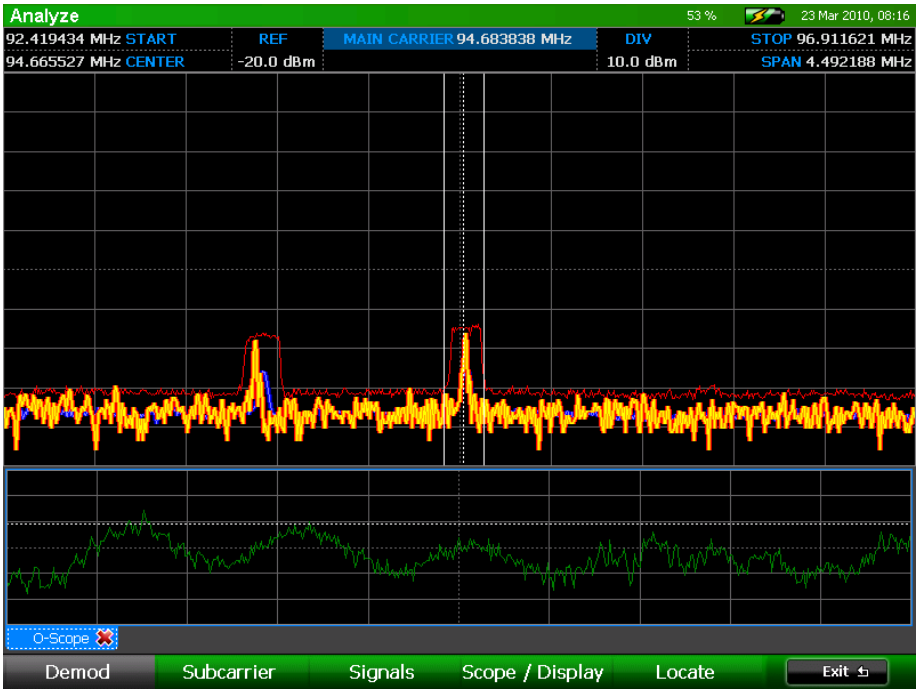
ANALYZE MODE

Analyze Mode changes the operation of the OSCOR from a sweep function to a single frequency signal analysis. The resolution bandwidth in Analyze Mode varies depending on the zoom level; it improves as you narrow the span. Analyze Mode will demodulate an analog AM, FM, or video signal.

To enter Analyze Mode:

1. Move the cursor to the frequency of interest (see page 32.)
2. Press the **SWEEP/ANALYZE** button.
3. The OSCOR unit will enter Analyze Mode.

Note: Analyze Mode can also be entered by using the *Analyze* icon found in Sweep Mode's *Signals* | *Signals* menu.



Analyze Mode Screen Elements

- **Spectral Graph** – displays a portion of the frequency spectrum, centered on the frequency where the cursor was located before entering Analyze Mode.
- **Oscilloscope** – an oscilloscope view of the demodulated signal. If video demodulation is not turned on, the oscilloscope will be positioned just below the spectral graph and will span the entire width of the display.

- **Video Display** – displays demodulated video. By default, video is not displayed when you enter Analyze Mode. Video Demodulation must be turned on by selecting the *Video* icon in the Demod Sub-Menu within Analyze Mode. (Not shown above)

Setting up the Analyze Mode Display

Several items on the Analyze Mode display can be customized depending on the information that needs to be seen on the screen:

Adjusting the Reference Level:

1. Select the reference level indicator "REF" at the top left of the screen with the stylus.
2. With the reference level indicator highlighted, enter a new reference level with the numeric keypad *or* scroll through possible values using the rotary dial.

Adjusting the dBm per screen division:

1. Select the dBm per screen division indicator "DIV" at the top right of the screen with the stylus.
2. With the "DIV" indicator highlighted, tap a second time with the stylus to display a drop down list with possible values. You can also use the rotary dial to scroll through possible values once the "DIV" indicator is highlighted.

Notes: To reset the reference level and the dBm/div value to the default, press the **OK** button and select *Default Range* from the context menu that pops up.

Demodulating an analog signal in Analyze Mode

After entering Analyze Mode, you must specify the type of demodulation and the filter bandwidth to use. By default, FM audio demodulation with a 200 kHz bandwidth is selected when first entering analyze mode. To change the demodulation scheme:

1. Within Analyze Mode, if you are not already in the Demod Sub-Menu, select *Demod* or press **F1**.
2. For **AUDIO** demodulation schemes:
    a. Audio demodulation is on by default when first entering analyze mode. If video demodulation has been turned on, press the *Video* icon to toggle it off and return to audio demodulation.
    b. Select the type of Audio Demodulation that you want to use: AM or FM
    c. Select the filter bandwidth that you wish to use: 12.75 MHz, 6.375 MHz, 800 kHz, 200 kHz, 12.5 kHz, 6.25 kHz, 2 kHz

d. By default, audio is muted when Analyze Mode is entered. Press **Mute** or adjust the volume using the **Vol^/v** keys to hear the demodulated audio through the OSCOR unit's speakers. You can also use headphones to listen to the demodulated audio. Plugging headphones into the headphone output will automatically mute the built-in speakers.

e. For improved clarity, adjust the Gain value.

The analyze screen for Audio Demodulation consists of two plots. The upper plot is the frequency spectrum. The lower plot is an oscilloscope view of the demodulated signal. Notice that the cursor in Analyze Mode is slightly different from Sweep Mode. The dotted vertical line represents the frequency of the main carrier. This value is displayed at the top center of the screen. The solid lines to either side of the dotted line represent the limits of the filter bandwidth selected in step 2c above.

3. For **VIDEO** demodulation schemes:

a. From the Demod Sub-menu, select the *Video* icon to change the demodulation scheme.

b. The OSCOR will automatically determine the video format of the signal that it is tuned to. It has the capability of decoding most variants of NTSC, PAL, & SECAM systems.

c. Select the type of demodulation that you want to use: AM or FM

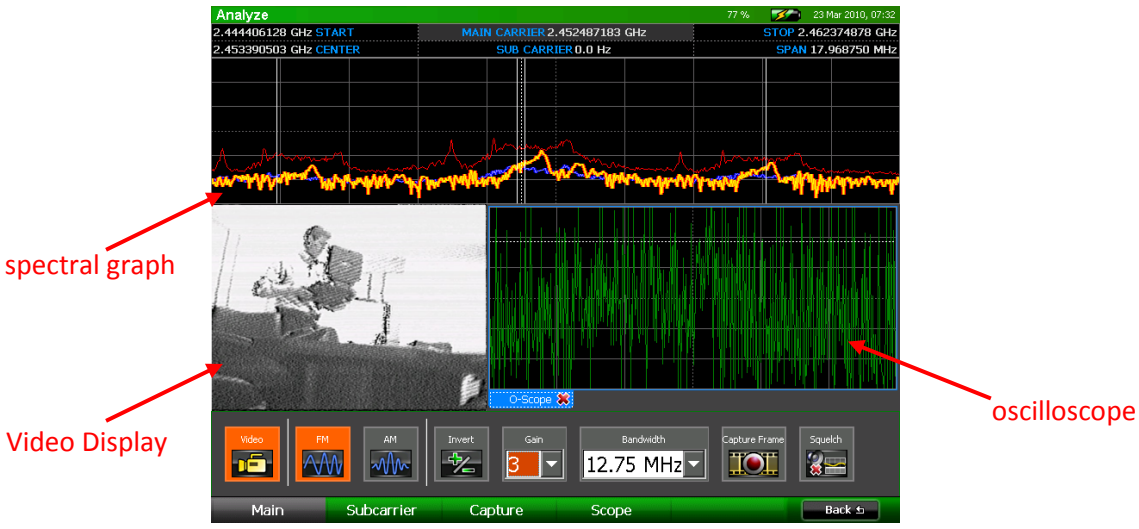
d. Select the filter bandwidth that you wish to use: 12.75 MHz, 6.375 MHz, 800 kHz, 200 kHz

e. The volume of the demodulated audio can be adjusted using the **Vol ^/v** keys on the OSCOR unit and can be muted with the **Mute** key.

f. For improved clarity, adjust the Gain value. You may find it helpful to use the oscilloscope display to assist with adjusting the gain. Adjust the gain until the demodulated video signal is easily seen on the oscilloscope at a good level without any clipping.

g. For video signals with an inverted sync pulse, the OSCOR provides the option of inverting the video signal. If you have adjusted the gain in the previous step using the oscilloscope so that the video signal is at a good level, but the OSCOR is still not demodulating any video, try toggling the *Invert* icon in the Demod Sub-Menu to get the video signal to tune in.

The analyze screen for Video Demodulation consists of the same two plots as the screen for Audio Demodulation, but adds a third element: a window for displaying demodulated video.



Changing the Scope Display in Analyze Mode

The display can be modified to suit your particular application.

1. From the Analyze Mode Menu, select *Demod* or press **F1**.

2. From the Demod Sub-Menu, select *Scope* or press **F4**. The Scope Sub-Menu will be displayed. The controls on the left side of the sub-menu pertain to the oscilloscope view for the main carrier demodulation. The controls on the right side of the sub-menu pertain to the oscilloscope view for subcarrier demodulation (see page 69).

3. From the Scope Sub-Menu, select the *Demod Scope* icon to toggle the display of the oscilloscope view.

4. From the Scope Sub-Menu, select the *Untrig Roll* icon (on the left side of the sub-menu) to change the scope trigger. With each press of the *Untrig Roll* icon the unit will cycle through the available scope triggers: Rising Edge, Falling Edge, and Untriggered Roll.

5. The displayed grid can also be varied to optimize signal analysis. From the **Time Div** drop down list that appears on the left side of the Scope Sub-Menu, select a value for the frequency of the vertical grid lines.

6. From the **Amp Div** drop down list that appears on the left side of the Scope Sub-Menu, select an amplification level for the horizontal grid lines: 1x, 2x, or 5x.

Setting a Squelch Level for Demodulated Audio

The squelch control will allow you to suppress demodulated audio output when the carrier of the currently tuned signal drops below a set threshold. This will prevent you from hearing white noise when, for example, demodulating the audio from a two way radio and no transmission is being sent. To set the squelch level:

1. From the Analyze Mode Menu, select *Demod* or press **F1**.
2. Select the *Squelch* icon. The audio, if previously muted, will un-mute and a horizontal cursor representing the squelch level will appear on the spectral graph.
3. Adjust the squelch level using the rotary knob. Ideally, this level should be set just above the noise floor so that when the audio signal drops into the noise floor, the audio is muted, but whenever an audio signal is present, you are able to hear the demodulated audio.

Recording and playback of demodulated audio

The OSCOR has the capability of recording demodulated audio as a .wav file for later playback or for analysis on another piece of equipment, such as a PC.

To capture demodulated audio using Quick Record:

Quick Record enables the user to quickly record up to 30 seconds of audio without first having to adjust the recording properties.

1. While demodulating an analog audio signal in Analyze Mode, from the Analyze Mode Menu, select *Demod* or press **F1** to enter the Demod Sub-Menu.
2. From the Demod Sub-Menu, select *Capture* or press **F3.**
3. From the Capture Sub-Menu, select the *Quick Record* icon. The OSCOR unit will begin capturing audio and the *Quick Record* icon will change to a *Stop Recording* icon.
4. To stop recording the audio at any point, select the *Stop Recording* icon. After 30 seconds of audio have been captured, the OSCOR unit will automatically stop recording. Once the audio recording has stopped, a dialog box will appear on screen.
5. In the dialog box that appears, select a location (either a USB flash drive or compact flash card), type a file name for the stored audio file and press *OK*. The OSCOR unit will save the captured audio in the specified location.

To record longer durations of demodulated audio:

Quick Record only allows capture of up to 30 seconds of audio. To record for longer durations it will be necessary to use the *Record Audio* icon and setup the location for file saving beforehand.

1. While demodulating an analog audio signal in Analyze Mode, select the *Record Audio* icon from the Demod| Capture Sub-Menu. A dialog box will appear on screen.

2. In the dialog box that appears, select a location (either a USB flash drive or compact flash card) for the stored audio file, type a file name and press *OK*. The OSCOR unit will begin saving the captured audio to this specified location.

3. During recording the *Record Audio* icon will be highlighted in orange. To stop recording the audio at any point, select the *Record Audio* icon again so that it is no longer highlighted.

To playback previously recorded audio:

1. From the Demod| Capture Sub-menu, select the *Play Audio* icon.

2. In the dialog box that appears, select an audio file for playback and press *OK*.

3. The audio file will begin playback. During playback, the *Play Audio* icon will be highlighted in orange. To stop playback before the end of the file is reached, select the *Play Audio* icon again so that it is no longer highlighted.

Capturing and reviewing a frame of demodulated video

The OSCOR unit has the capability of storing a frame of demodulated video as a .png file or .bmp file for later display.

To capture a frame of demodulated video:

1. While demodulating an analog video signal in Analyze Mode, select the *Capture Frame* icon from the Demod | Main Sub-Menu. The *Capture Frame* icon is also available from the Demod | Capture Sub-Menu.

2. In the dialog box that appears, select a location (either a USB flash drive or compact flash card), type a file name for the stored image, select a file type (either .png or .bmp) and press *OK*.

3. The OSCOR unit will capture the current frame of demodulated analog video and save it in the specified location.

To display a previously captured frame of video:

1. From the Analyze Mode menu, select *Demod* or press **F1**. From the Demod Sub-menu, select Capture or press **F3.**
2. From the *Capture* Sub-Menu, select the *View Frame* icon.
3. In the dialog box that appears, select a stored video frame for viewing. It may be necessary to change the file type (either .png or .bmp) in the dialog box to view previously stored frames. Press *OK*.
4. The stored video frame will be displayed on the screen. Press *Close* or **F6** to close the image.

Note: This feature will only display previously captured demodulated video frames. To view other images, such as screen shots, use the *View Image* feature located under the System Menu in Sweep Mode.

Toggling the Traces in Analyze Mode

By default, three traces are displayed each time you enter Analyze Mode: the real time trace, an average trace, and a peak trace. The real time trace is displayed in yellow, the average trace in blue, and the peak trace in red. Observing all three traces together will help with signal analysis and will aid in catching signal details that might be missed by only displaying one of these traces. However, the display of each of these traces can be toggled on/off:

1. From the Analyze Mode Menu, select *Display* or press **F2**.
2. From the Display Sub-Menu, select the *Realtime* icon or the *Average* icon to toggle the display of the real time trace and average trace. Repeatedly press the *Peak: Hold* icon until it reads *Peak: Off* to turn off the peak trace.

Changing the Peak Trace Type in Analyze Mode

By default, when you first enter Analyze Mode, the displayed peak trace will continue building until it is cleared. The peak trace type can be changed to a decaying peak which will slowly release each peak after a small amount of time:

1. From the Analyze Mode Menu, select *Display* or press **F2**.
2. From the Display Sub-Menu, repeatedly press the *Peak: Hold* icon until it reads *Peak: Decay*.

Demod FFT/Subcarrier Demodulation

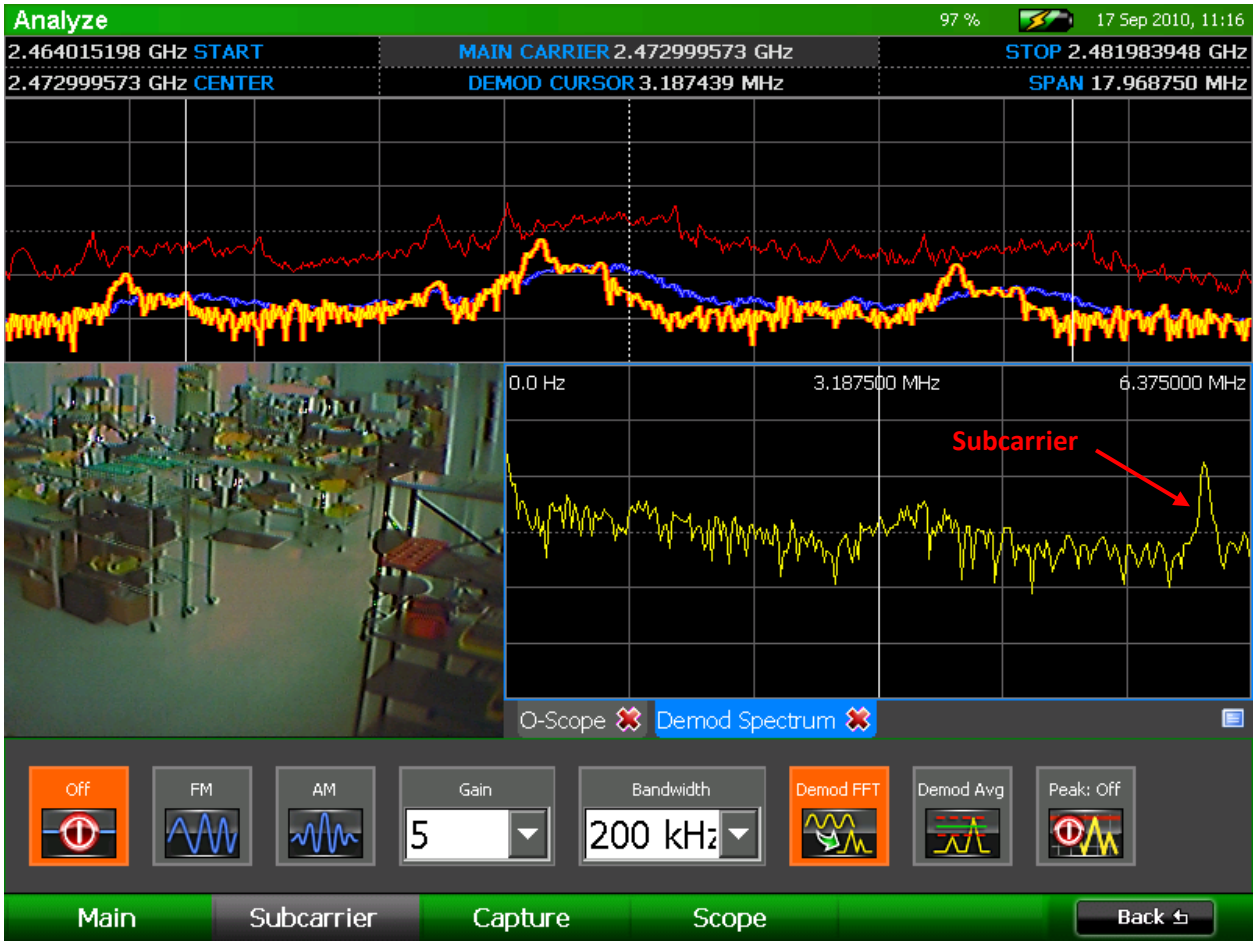
Subcarrier demodulation is a means of decoding a second “piggy backed” signal carried on a normal transmitted radio signal. Subcarrier demodulation is sometimes referred to as double demodulation. Subcarrier signals are used for transmitting a number of things including stereo audio information, metadata, color information, and even audio for video signals. While performing an audio or video demodulation, to demodulate an audio sub carrier:

1. Demodulate a known video or audio signal. In order to demodulate a subcarrier, you must already be tuned to and demodulating a main carrier.

2. From the Analyze Mode Menu, select *Demod* or press **F1** to enter the *Demod* Sub-menu.

3. From the *Demod* Sub-menu, select *Subcarrier* or press **F2** to enter the *Subcarrier* Sub-menu.

4. Select the *Demod FFT* icon. A new tabbed window, Demod Spectrum, will appear displaying a frequency domain representation of the demodulated signal. If there are any subcarriers present, they will be easy to detect using the demodulated spectrum. In order to tune subcarriers you must open the Demod Spectrum window. Select the *Demod Avg* icon to turn on an average trace for the Demod Spectrum. This may make it easier to detect subcarriers.



5. Once a subcarrier is identified, turn on subcarrier demodulation by selecting the type of demodulation that you want to use from the Subcarrier Sub-Menu: AM or FM.

6. Select the bandwidth that you wish to use: 200 kHz, 12.5 kHz, or 6.25 kHz. The 200 kHz subcarrier bandwidth is only available if the demodulation bandwidth is greater than 200 kHz.

7. Tap the Demod Spectrum window with the stylus or your finger to select it. Once this window has focus, you can use the rotary knob to tune the subcarrier cursor or type in a value using the numeric keypad. To adjust the main carrier frequency, tap the main spectral graph at the top of the screen.

8. The demodulated audio will be heard through the speakers or headphones. The volume of the audio can be adjusted using the **Vol ^/v** keys on the OSCOR unit and can be muted with the **Mute** key.

9. For improved clarity, adjust the Gain value.

10. To turn off subcarrier demodulation, select the *Off* icon from the Subcarrier Sub-Menu.

Note: Subcarrier demodulation is only available for video demodulation and the four larger filter sizes (200 kHz, 800 kHz, 6.375 MHz, 12.75 MHz) for audio demodulation.

Note: A peak trace is also available for the Demod Spectrum. From the Subcarrier Sub-Menu, select the *Peak: Off* icon until it says *Peak: Hold* or *Peak: Decay.*

Subcarrier Scope

An oscilloscope display is available for displaying the demodulated subcarrier signal.

Enabling the Subcarrier Scope

1. From the Analyze Mode Menu, select *Demod* or press **F1**.

2. From the Demod Sub-Menu, select *Scope* or press **F4**. The Scope Sub-Menu will be displayed. The controls on the left side of the sub-menu pertain to the oscilloscope view for the main carrier demodulation. The controls on the right side of the sub-menu pertain to the oscilloscope view for subcarrier demodulation (see page 69).

3. From the Scope Sub-Menu, select the *Sub Scope* icon to toggle the display of the subcarrier oscilloscope.

Changing the Subcarrier Scope Display

1. From the Demod | Scope Sub-Menu, select the *Untrig Roll* icon (on the right side of the sub-menu) to change the subcarrier scope trigger. With each press of the *Untrig Roll* icon the unit will cycle through the available scope triggers: Rising Edge, Falling Edge, and Untriggered Roll.

2. The displayed grid can also be varied to optimize signal analysis. From the **Time Div** drop down list that appears on the right side of the Scope Sub-Menu, select a value for the frequency of the vertical grid lines.

3. From the **Amp Div** drop down list that appears on the right side of the Scope Sub-Menu, select an amplification level for the horizontal grid lines: 1x, 2x, or 5x.

Signal Lists in Analyze Mode

Signal lists that are created in sweep mode are accessible in analyze mode to facilitate signal analysis. Signal list functions in Analyze Mode are very similar to their Sweep Mode counterparts (see page 47). These functions can be accessed in Analyze Mode by selecting *Signals* from the main Analyze Mode menu or pressing **F3**. There are two sub-menus within the Signals Menu: *Lists* (**F1**) and *Signals* (**F2**).

The following functions are available in the *Signals*|*Lists* Sub-Menu:

- **New–**Opens a blank signal list to which signals can be manually added in Analyze Mode.
- **Open List**–Opens previously saved signal lists.
- **Close List** – Closes a signal list that is open. If the signal list has not been saved up to that point, you will be asked whether or not to save the list.
- **Save –** Saves the currently open signal list
- **Save As –** Allows the saving of the currently open signal list to a new filename or a new location
- **Merge** – Merges multiple signal lists (see page 49).
- **Auto Analyze** - For each signal in a signal list, Auto Analyze will automatically fine tune the main carrier frequency and bandwidth measurements. For any analog signals, Auto Analyze will also determine whether or not the demodulated audio correlates with room audio. (See page 53.)

The following functions are available in the *Signals*|*Signals* Sub-Menu:

- **Add** – Adds a signal to the signal list at the cursor's current position. If a signal list is already open, the signal will be added to this list. If no signal list is open, a new list will be created with this signal added.
- **Remove** – Removes the currently highlighted signal from displayed signal list.
- **Edit** – Add additional information, such as location, threat, and comments, to the currently selected signal in the signal list. Also, the frequency, amplitude and bandwidth values of the currently selected signal can be tweaked with the Edit icon.
- **Previous –** The cursor will move to the signal in the Signal List with the next lowest frequency.
- **Next** – The cursor will move to the signal in the Signal List with the next highest frequency.
- **Closest** – If the cursor is not already positioned on a signal in the currently open signal list, it will move to the closest one.

The following functions are available in the *Signals*|*Options* Sub-Menu:

- **Show List** – Toggles the display of Signals tab
- **Markers** – Toggles the display of markers in the spectrum graph for any currently opened signal list

Locating Signals

RSSI Locate

The OSCOR includes an RSSI locating feature to aid in narrowing down the physical location of a bug. RSSI stands for Relative Signal Strength Indicator.

Opening the RSSI Locate Window

1. Position the cursor on the frequency of the signal suspected to be transmitting from your immediate area (see page 32).
2. Press the **Sweep/Analyze** button to enter Analyze Mode.
3. From the Analyze Mode Menu, select Corr / *Locate* or press **F4**.
4. The RSSI Sub-Menu should be visible. If it is not, select *RSSI* or press **F1**.
5. From the RSSI Sub-Menu, select the *RSSI Level* icon. An RSSI graph displaying the RSSI level of the signal versus time will open in a tabbed window beneath the spectral graph.
6. Press the *RSSI Level* icon again to turn off the RSSI graph.

Several other tasks related to the RSSI Locate function can be performed from the Locate Sub-Menu.

- *Time* – Use the time drop-down box to adjust the amount of time represented by the horizontal span of the graph. Selecting a larger time increment will allow more data to be shown on the display at one time.

- *Threshold* – The relative level of the RSSI graph can be adjusted to make it easier to see small variations in signal strength. Select the *Threshold* icon from the Locate Sub-Menu and then adjust the threshold level using the rotary knob. Press **OK** when you are done.

- *Clear RSSI* – Select the *Clear RSSI* icon to erase the currently displayed RSSI graph and begin collecting RSSI data again.

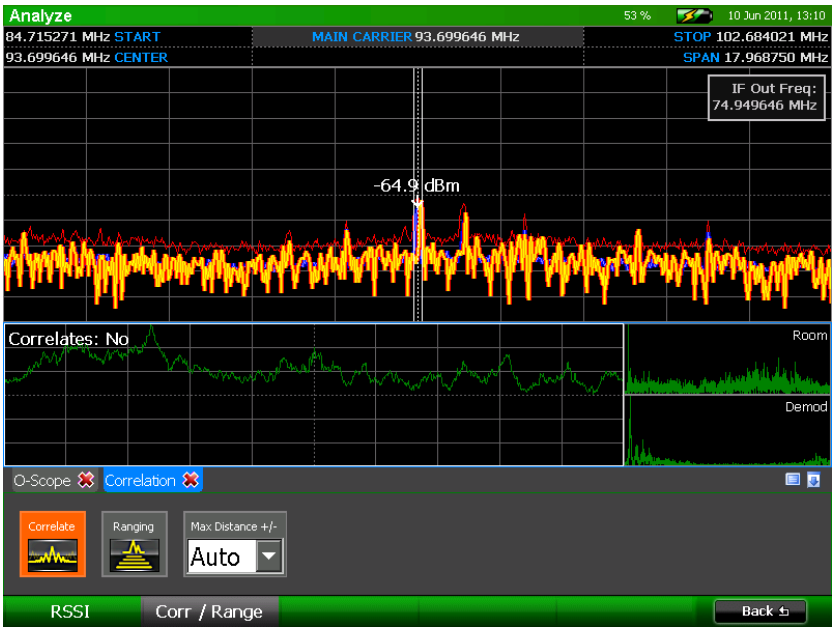
Correlation

The correlation function allows the OSCOR unit to identify a demodulated analog audio signal as an eavesdropping device. It compares complex sound patterns in the ambient room noise to the demodulated audio to determine if they correlate or match.

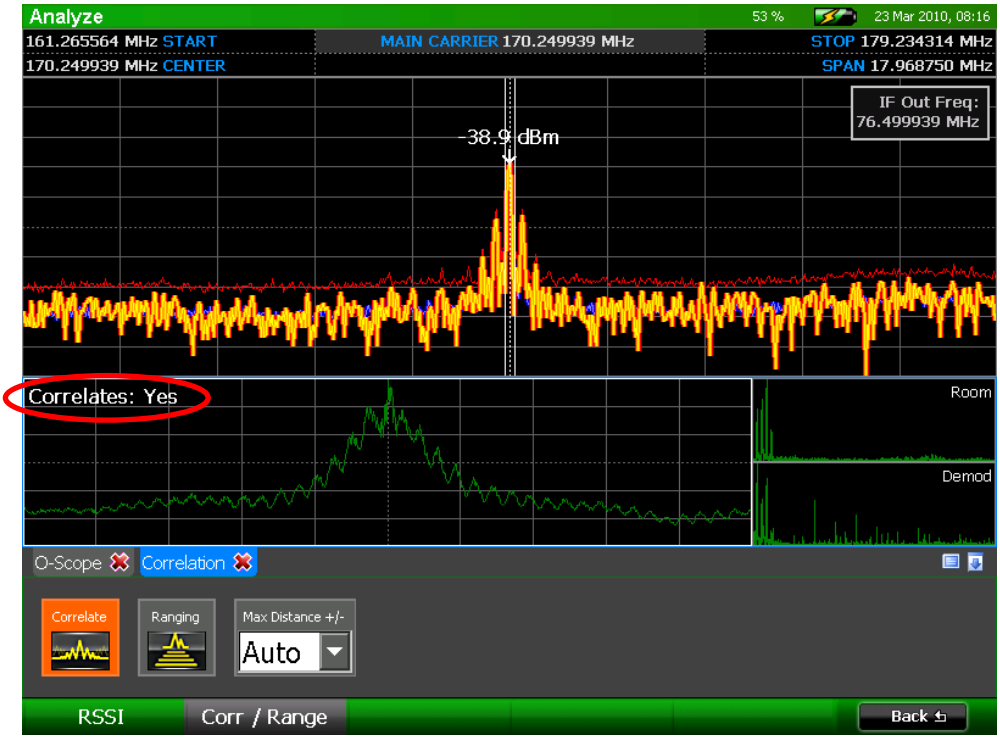
To use the correlation function:

1. Ensure that the audio from the OSCOR unit is muted. *If the demodulated audio is playing from the OSCOR unit's speakers it will be picked up by the OSCOR's microphone, which will always result in a correlation. If you wish to listen to the demodulated audio signal while using the correlation feature, use headphones.*
2. While demodulating an analog video signal, select Corr / *Locate* or press **F4** from the Analyze Mode Menu. (Note: From the Demod Submenu, it will be necessary to select *Back* or press **F6** to return to the Analyze Mode Menu.)
3. From the Corr / Locate Submenu, select *Corr / Range* or press **F2**.
4. From the Corr / Range Submenu, select the *Correlate* icon. A new tabbed window, Correlation, will appear displaying a correlation graph.

Random data throughout the graph indicates that the demodulated audio does not correlate with room audio.



An increased level in the center of the graph is an indication that the demodulated signal correlates with room audio and could be a potential threat. The OSCOR unit will automatically assess the correlation graph and make a determination regarding whether or not the demodulated audio correlates with the ambient room noise. The unit's determination is displayed on the top left hand side of the correlation graph.



To the right of the correlation graph, the OSCOR unit displays frequency domain graphs of the two audio signals it is comparing to make its correlation determination. The graph labeled "Room" is the room

audio as received by the microphone on the OSCOR. The graph labeled "Demod" is the demodulated audio from the currently tuned signal.

Note: Ideally, for an accurate correlation determination, the most prominent sound source heard by the OSCOR unit should also be the most prominent sound heard by the bug. It may be advantageous to have an easily perceptible, non-periodic sound source in the room; music or conversation in an otherwise silent room should work well. It may also be beneficial to walk around the room with the OSCOR unit to increase the chances of both the OSCOR and the bug hearing the same ambient noise. The fan noise from the unit, although it may be almost imperceptible as far as ambient noise is concerned, will be very significant to the OSCOR's speakers. This should be taken into account when checking for correlation.

Warning: If the OSCOR determines that there is no correlation between demodulated audio & ambient room noise, it does not necessarily mean that the signal is not a threat; it only means that the signal does not acoustically correlate with the selected form of demodulation. Signals that are digitally modulated, spread spectrum, frequency hopping, or contain video content will not correlate. To locate the source of these types of signals, you will need to use other methods, such as RSSI level (see page 73) or RF mapping, a process taught in REI's TSCM training classes. Contact REI (sales@reiusa.net) for training dates.

Ranging

The ranging function uses a sound source and the speed of sound to calculate the range of a correlated signal.

For the most accurate ranging information, the OSCOR unit features a white noise generator, which is used for the sound source. However, it is important to note that this may alert others to your counter surveillance activities.

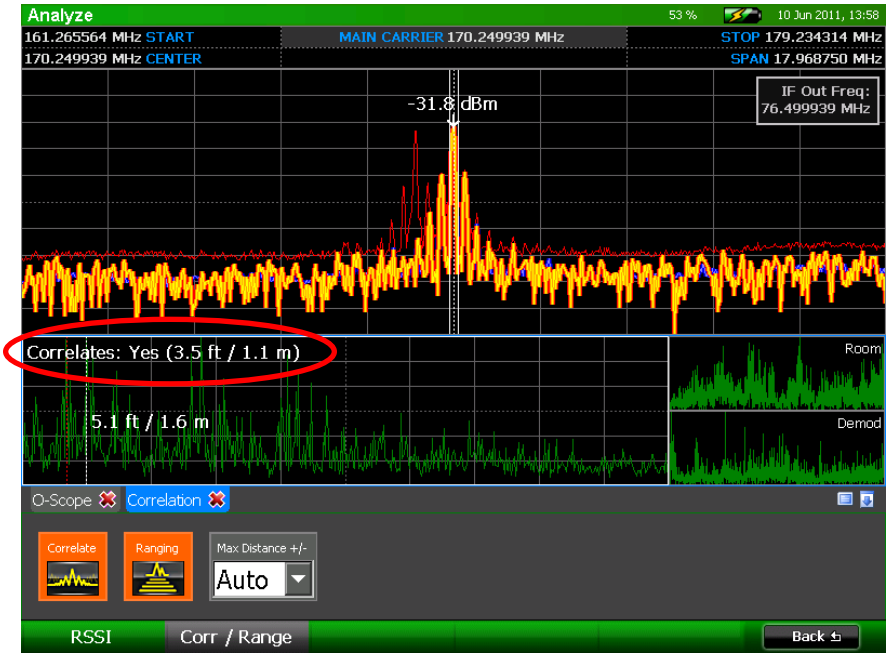
Note: If during the correlation phase, headphones were used to listen to demodulated audio, it will be necessary to unplug the headphones from the OSCOR unit during the ranging phase. The white noise generated by the OSCOR needs to be picked up by the unit's internal microphone and by the potential eavesdropping device. For this to occur there can be no headphones plugged into the headphone jack on the OSCOR unit, so that the white noise is heard from the OSCOR unit's built-in speakers.

To use the ranging function:

1. If during the correlation phase described above, a demodulated signal correlates with room audio, the OSCOR unit is able to determine the distance, or range, from the OSCOR to the listening device. To determine this distance, select the *Ranging* icon from the Corr | Range submenu. Note: The *Ranging* icon cannot be selected unless the *Correlate* icon is highlighted.
2. If the audio of the OSCOR unit is currently muted, you will be presented with a dialog box asking if you wish to unmute for ranging. Select *OK* or press **F5** to unmute the audio and use white

noise generated by the OSCOR to perform the ranging function. Select *Cancel* or press **F6** if you have decided not to use the ranging function.

3. By comparing the white noise received by the built-in mic and that received through the demodulated audio it makes a determination as to how far away the eavesdropping device is. The distance determined by the unit is displayed at the top left hand side of the correlation graph in parentheses after the correlation determination.

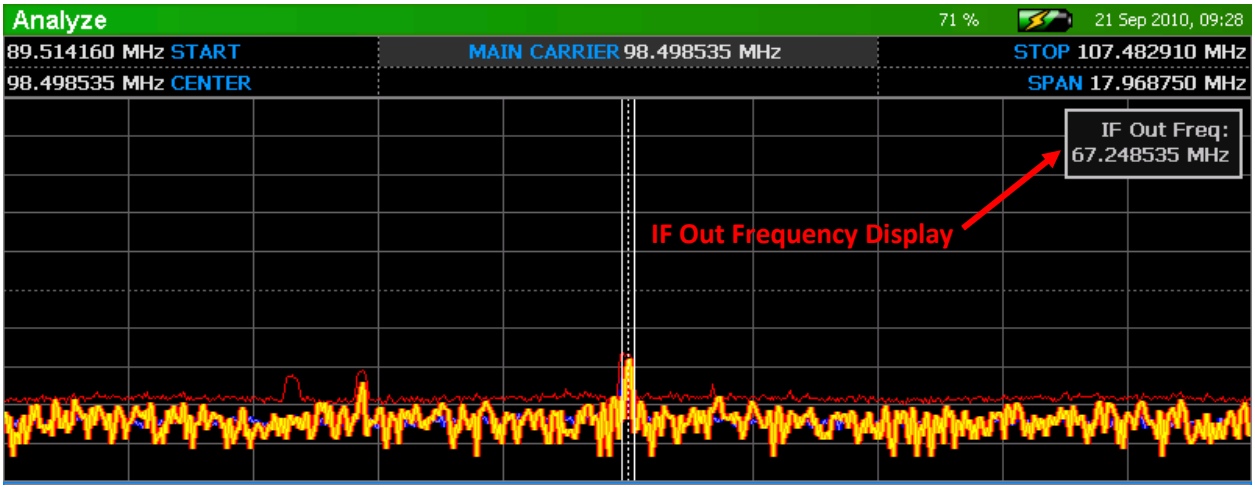


4. The *Max Distance +/-* drop down box can be used to zoom in on the correlation graph to see more detail. To zoom in, select a smaller distance.
5. The OSCOR unit will automatically detect which peak is the generated white noise and display the distance to the eavesdropping device. A red cursor with an arrow is used to indicate the peak that the OSCOR unit has detected as the sound source. The white cursor that also appears on the correlation graph is adjustable and can be used to determine distances for the various peaks of the correlation graph. Tap the correlation graph with your finger or stylus so that it has focus and you can use the rotary knob to change the position of the cursor. Each peak on the correlation graph represents a sound source or reflection that is being detected by both the OSCOR and the eavesdropping device.

6. While using the ranging function, walk around the room carrying the OSCOR unit. The distance indicated by the ranging function will get smaller as you near the eavesdropping device. It should be noted that this particular step could be alerting to a potential eavesdropper.

IF Out

The IF Out port (see page 5) is active anytime that the OSCOR unit is in Analyze Mode. The center frequency of the IF Out is 75 MHz with a 3 dB bandwidth of 30 MHz. Any signal centered on the spectrum window will appear at the IF out port, but due to the hardware configuration of the OSCOR it will not be centered at 75 MHz. To assist with identifying signals on the IF port, the IF Out Frequency of the current cursor position is displayed in Analyze Mode.



To turn the IF Out display off or on:

1. From the Analyze Mode Menu, select *Display* or press **F2**.

2. From the Display Sub-Menu, select the *Show IF Out* icon to turn the IF Out display on. Deselect the *Show IF Out* icon to turn the IF Out display off.

Baseband Out

The Baseband Out port (see page 5) can be used to supply a demodulated baseband signal to external equipment for further analysis, e.g. running a video signal to external monitors. It is available anytime the OSCOR unit is demodulating an analog signal using the 12.75 MHz, 6.375 MHz, 800 kHz, or 200 kHz bandwidth filters.

To activate the Baseband Out Port while demodulating an analog signal:

1. From the Analyze Mode Menu, select *Options* or press **F5**.

2. From the Options Sub-Menu, select the *Baseband Out* icon to turn the Baseband Out port on. Deselect the *Baseband Out* icon to turn the Baseband Out port off.

Note: Whenever the Baseband Out port is *on*, the video display on the OSCOR unit will lose color. This is normal and is due to hardware limitations in the unit.

Note: The Baseband Out port has no low pass filter and may contain alias images.

Cursor Lock

For many of the operations in Analyze Mode, you may find it useful to lock the cursor for the main carrier so that the tuned frequency doesn't accidentally change during analysis.

To lock the main carrier cursor:

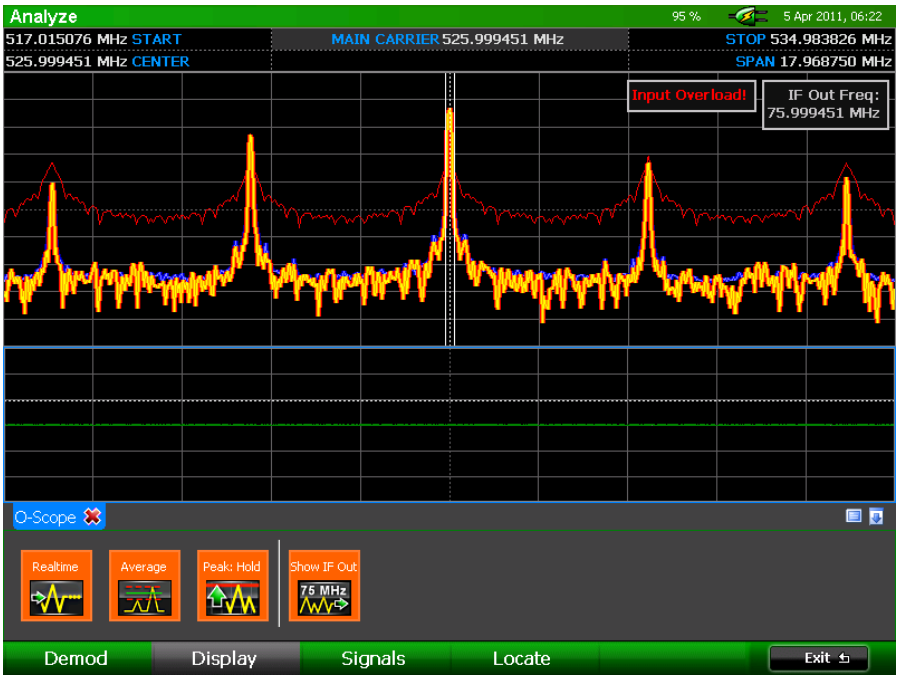
1. From the Analyze Mode Menu, select *Options* or press **F5**.

2. From the Options Sub-Menu, select the *Lock Cursor* icon to lock the cursor for the main carrier. Deselect the *Lock Cursor* icon to unlock the cursor.

Receiver Overload – Analyze Mode

Just as with sweep mode, a receiver overload condition in Analyze Mode can cause intermodulation distortion and false spurs. The overload indicators used in Sweep Mode were described on page 60. For analyze mode, an overload condition is indicated by the warning text "Input Overload!" in the upper right hand corner of the spectrum graph.

The "Input Overload!" warning indicates that an overload condition has occurred somewhere within the displayed spectrum. To fix the overload condition, apply the smallest amount of input attenuation (see page 27) that is necessary to get rid of the "Input Overload!" warning. Begin by applying 10 dB of attenuation. If 10 dB of attenuation will not get rid of the "Input Overload!" warning and the false spurs, then try 20 dB, and then 30 dB.



In the screenshot above, a very strong signal has caused an overload condition, creating several false spurs and causing the “Input Overload!” indicator to appear on the spectrum.

Applying just 10dB of input attenuation has eliminated the overload condition. The overload indicator has disappeared along with all of the false spurs.

THE MULTI-PURPOSE PROBE (MPP)

The multi-purpose probe, or MPP, is a small portable probe that attaches to the auxiliary port of the OSCOR unit and extends its functionality with the addition of different sensors/antennas to allow the capture and analysis of suspicious signals: Coaxial Connectors, Carrier Current Probe (CCP), VLF Antenna (Loop Antenna), Infrared (IR) sensor, and a Visible Light (VL) sensor.

The table below summarizes the frequency range for each sensor/antenna and the wavelength range for each of the photo sensors.

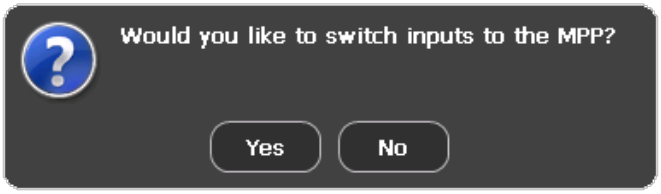
Sensor/Antenna	Frequency Range	Wavelength Range
Coax (In-Line & Single-Ended)	5 MHz – 2 GHz	*Not Applicable*
CCP (Carrier Current)	50 kHz – 150 MHz	*Not Applicable*
VLF (Loop Antenna)	20 kHz – 20 MHz	*Not Applicable*
IR (Infrared Light)	50kHz – 1.2 GHz	700 – 1100 nm
VL (Visible Light)	50 kHz – 1.2 GHz	450 – 1100 nm

Connecting the MPP to the OSCOR Unit

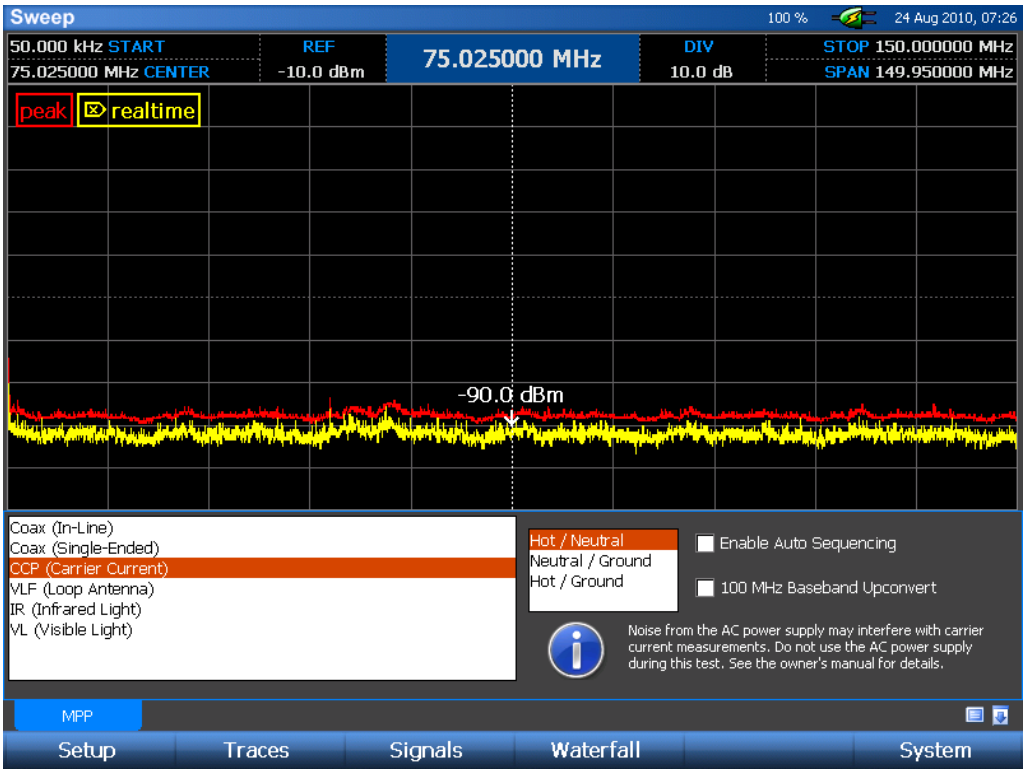
1. Pushing on the edge of the VLF antenna (see page 90), slide it open far enough that you are able to unwind the MPP cable.
2. The MPP has two connectors on the end of the cable: an 8-pin circular connector and an SMA connector.

3. Connect the 8-pin circular connector to the AUX jack on the back of the OSCOR unit.
4. Connect the SMA connector to the 0-8 GHz auxiliary jack to the right of the AUX jack.

5. Upon connecting the MPP, if the OSCOR unit is powered on and using the built-in antenna panel, you will be presented with a dialog box.



6. Select *Yes* or press **F5** to switch the RF input to the MPP. The *Aux RF* icon in the Setup Menu will be replaced with an *MPP* icon. Also, a tabbed panel will be added displaying options for all of the inputs.



Notes

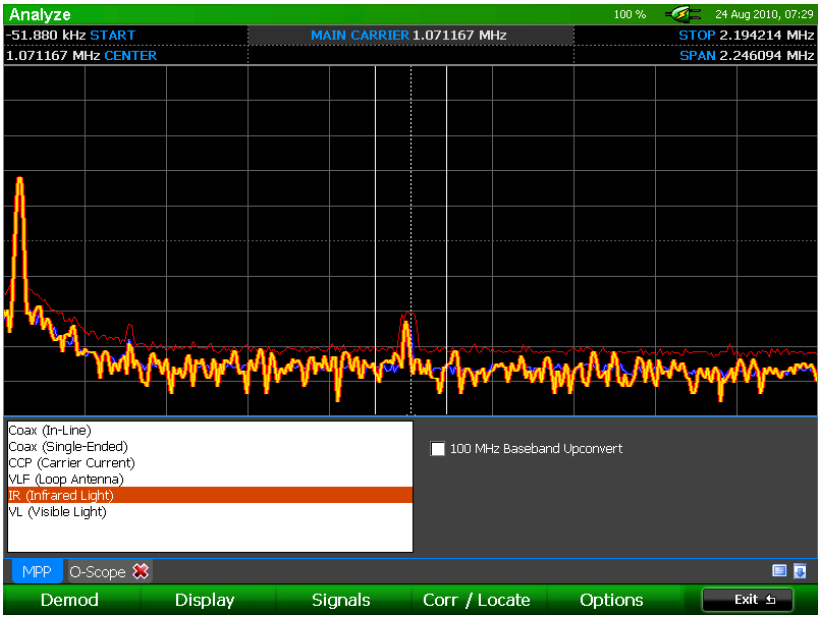
- If you select *No* when prompted to switch inputs to the MPP, the OSCOR unit will continue to use the built-in antenna panel. To switch to the MPP input at a later point, select the *MPP* icon from the Setup Sub-Menu.

- Avoid connecting the MPP during start-up of the OSCOR unit; either connect the MPP before the unit is powered on *or* wait until the boot sequence is finished.

OSCOR Unit Operations with the MPP connected

Most of the OSCOR operations continue to operate with the MPP just as they do with the built-in antenna panel. The maximum frequency range will automatically be adjusted for whichever MPP input is selected; however all the other functions will operate the same. You can use the preamp or attenuators, narrow in on specific frequencies, save a peak trace, look at an average trace, turn on detail zoom, and generate a signal list. If a signal is detected, you can go to analyze mode and even demodulate any analog signals that might be present.

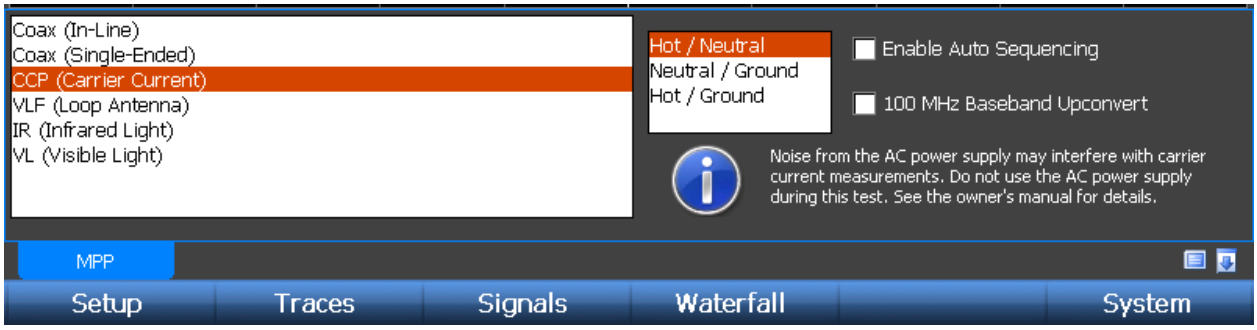
Caution: Switching between MPP inputs will clear the peak trace. Be sure to save the peak trace before switching probes for any data you wish to keep.



Selecting an MPP Input

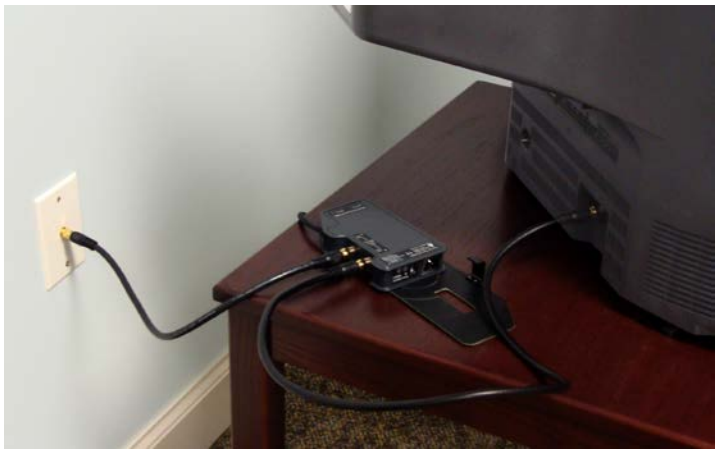
Only one sensor or antenna on the MPP can be active at any given time. To activate a sensor or antenna, select it from the list in the MPP tab by tapping it with the stylus.

After selecting an input from the list in the MPP tab, options for that input will be displayed on the right side of the MPP tab. Options vary according to the selected input.



Coax (In-Line)

Two of the MPP functions utilize the coaxial connectors: Coax (In-Line) and Coax (Single-Ended). The Coax (In-Line) Setting allows you to make in-line measurements using one of the coax ports as an input and the other as an output. The MPP contains a directional coupler between port A and port B. Therefore, if a signal is originating from the Port A coax input, then the signal should appear stronger when the MPP is switched to port A versus port B. This technique can be used to determine if a signal is originating from either the port A or port B side of the coax without having to physically switch the cables on the inputs.



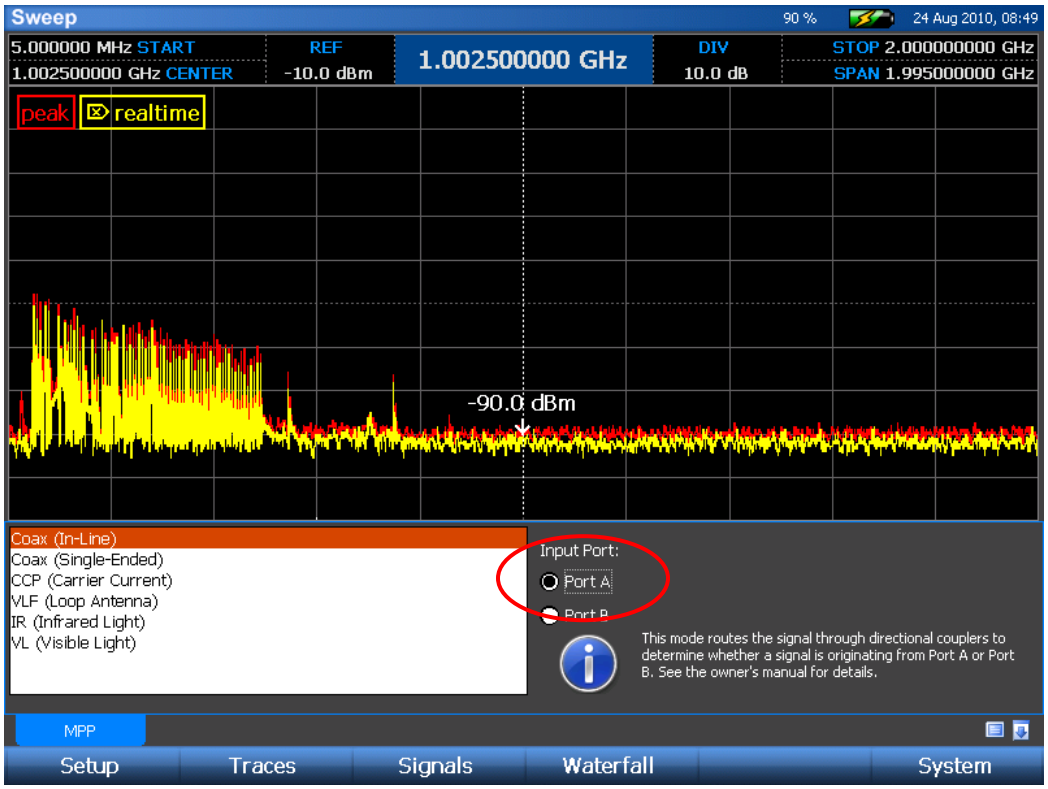
To use the Coax (In-Line) Input:

1. If making an in-line measurement on the coax cable from a wall outlet to a television, disconnect the coax cable from the back of the television. Connect this cable to Coax Port A on the MPP.

2. Take the extra length of coax cable included with your OSCOR unit and connect Coax Port B on the MPP to the television. Signal will be restored to the television.

3. On the OSCOR, make sure that the “Coax (In-Line)” input is selected on the MPP tab. On the right side of the tab, the options for the selected input will appear.

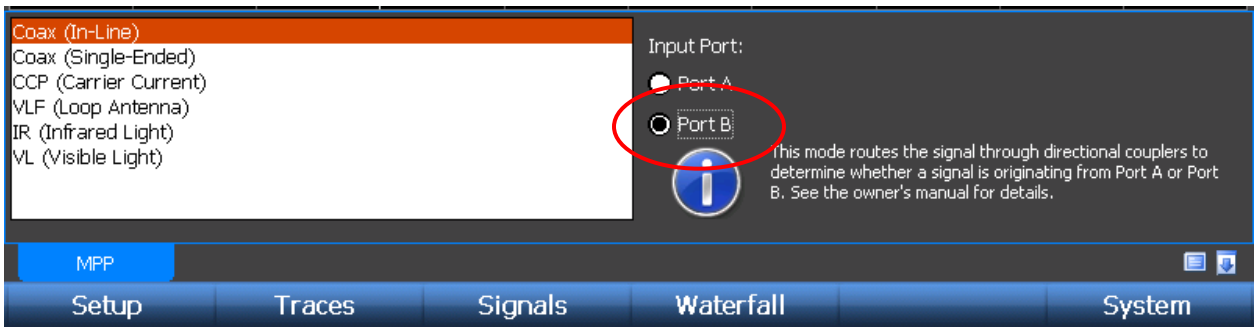
4. On the options panel, select Port A as the input port. Observe any signals present on Port A.



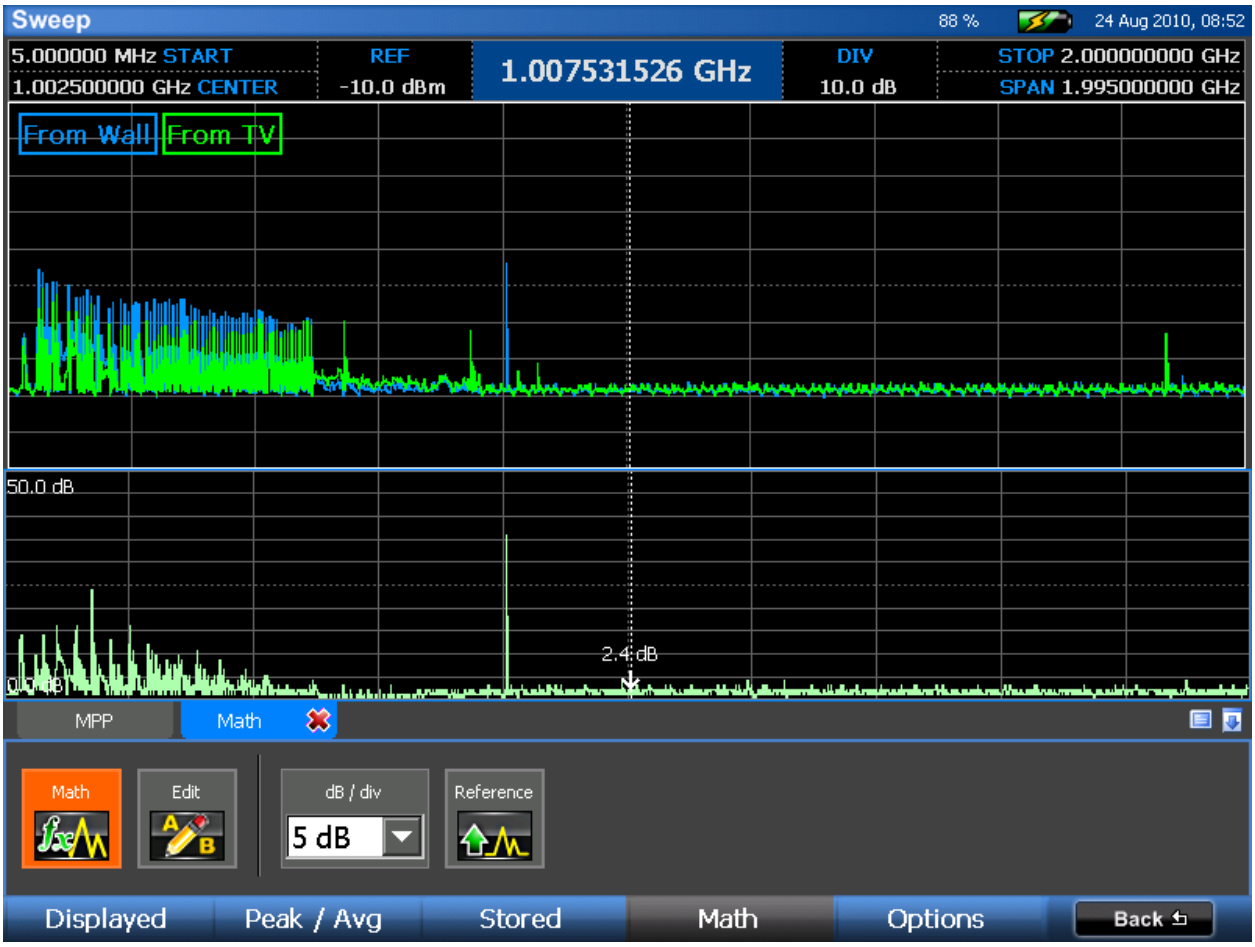
5. It is advisable to save this trace for later comparison. Select *Traces* from the Main Menu or press **F2**. From the Traces Sub-Menu, select *Peak / Avg* or press **F2**. Select the *Save Peak* icon from the Peak/Avg Sub-Menu.

6. Clear the peak trace before moving on to the next step. While still in the Peak/Avg Sub-Menu, select the *Clear Peak* icon.

7. On the options panel of the MPP tab, select Port B as the input port. Observe any signals present on Port B. *Remember, because the two inputs are coupled, any signal seen at one input will be present at the other also, but at an attenuated level, so comparing traces from each input will give you a pretty good idea which side the suspicious signal is originating from.*



8. Repeat step 5 to save a Peak Trace from Port B. The two saved peaks can now be compared to identify possible suspect signals. A math trace can also be performed on these two peaks (see page 41)



Notes:

- Always verify the directionality of any suspicious signal by connecting each side up individually.

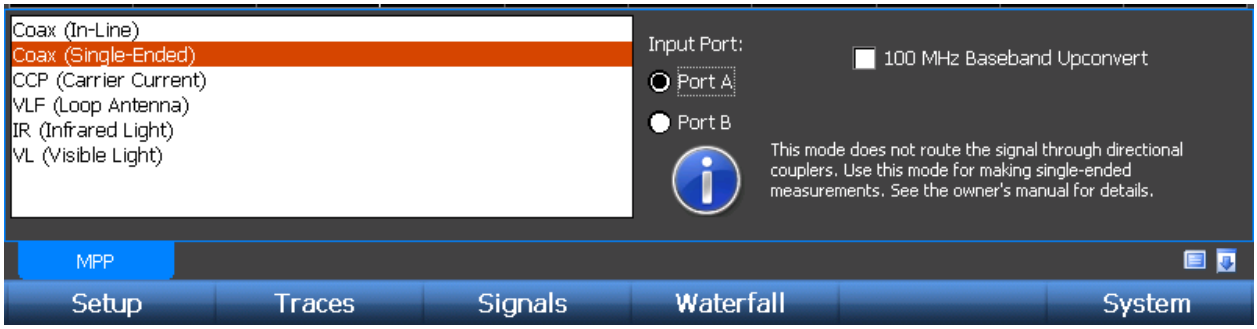
Coax (Single-Ended)

The coax connectors on the MPP can also be used for single-ended measurements.

To measure signals using the Coax (Single-Ended) inputs:

1. Connect the signal up to either coax port A or port B. Be sure and connect the 75 ohm terminator included with the OSCOR to the remaining port.

2. On the OSCOR unit, make sure that the "Coax (Single-Ended)" input is selected. The options for the Coax (Cable TV) input will appear on the right side of the MPP tab. From the options panel, select the port that the cable is connected to.



Notes

- The coax connectors on the MPP can be used as general purpose inputs. Any type of signal in the 5 MHz to 2 GHz range may be connected to these inputs for measurement. Adapters may be necessary to connect to the F-type connectors. *Adapters are not included as part of the OSCOR Unit.*

- The coax connectors are coupled even when in Coax (Single-Ended) mode. Because of this, any signal connected to one of the ports will be seen at the other port. As such, Coax (Single-Ended) mode will act very similar to Coax (In-Line) mode, however, the directionality component is not as strong but there is less overall attenuation. Therefore, it is best to use Coax (In-Line) mode to determine the directionality of an in-line measurement without having to physically switch the inputs and to use Coax (Single-Ended) mode when making single-ended measurements.

- Because the two coaxial connectors are coupled and because any signal connected to one of the ports will be seen at the other port, it is not advisable to connect two different signals to ports A and B at the same time.

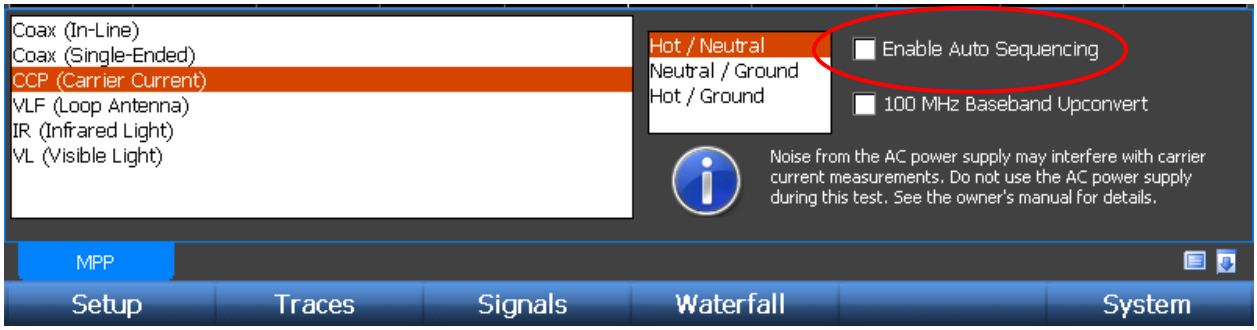
- The 100 MHz Baseband Upconvert option mixes the signal with a 100 MHz signal for analyzing baseband (see page 93).

CCP (Carrier Current Probe)

The CCP (Carrier Current) input can be used to test for carrier current signals on any pair of conductors less than 250 volts. Before testing an unidentified pair of power conductors, a voltmeter should be used to measure the voltage across the conductors. **If this voltage exceeds 250 volts, do not test with the MPP.**

To measure carrier current with the MPP:

1. Ensure that the battery level of the OSCOR is enough to power the unit.
2. Remove the power cord from the AC adapter used to power the OSCOR unit.
3. Plug the power cord into the Carrier Current Input on the MPP.
4. Plug the other end of the power cord into the outlet you wish to check.
5. On the OSCOR unit, make sure that the "CCP (Carrier Current)" input is selected. The options for CCP testing will appear on the right side of the MPP tab.
6. Measurements can be made with three different pair configurations: Hot/Neutral, Neutral/Ground, and Hot/Ground.
7. To automatically switch between all three different pair configurations, select "Enable Auto Sequencing." The MPP will automatically rotate through the pair selections after a few seconds each.



Notes

- Noise from the AC power supply may interfere with carrier current measurements. Be sure that the AC power supply for the OSCOR unit is not plugged into the electrical circuit that you are testing for carrier currents.

- Be aware that any switching power supply connected to the electrical circuit that you are measuring may affect carrier current measurements

- The 100 MHz Baseband Upconvert option mixes the signal with a 100 MHz signal for analyzing baseband (see page 93).

- A break-out cable with alligator clips is included with the OSCOR unit for use with the carrier current input. *This cable should not be used with power circuits.*

VLF (Loop Antenna)

The VLF (Very Low Frequency) input uses a loop antenna for analyzing the RF spectrum at low frequencies.

To measure signals with the VLF Loop Antenna:

1. Lift slightly on the end of the loop antenna and slide all the way open for use.

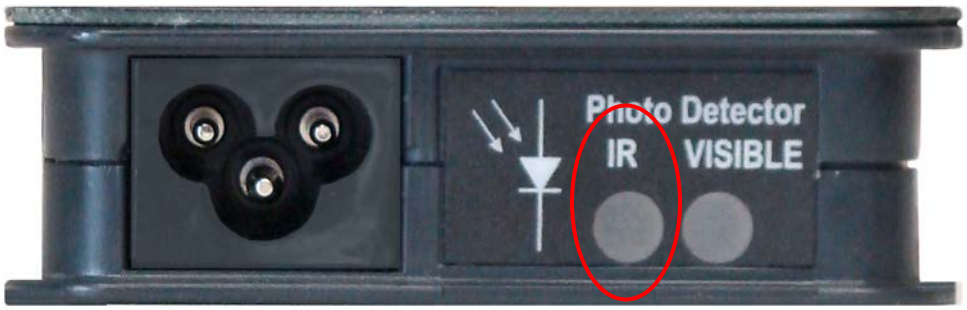
2. On the OSCOR unit, make sure that the “VLF (Loop Antenna)” input is selected.

Notes

- The displayed frequency range in Sweep Mode for the VLF antenna is from 50 kHz to 20 MHz. To evaluate signals down to 20 kHz, switch to analyze mode.
- The 100 MHz Baseband Upconvert option mixes the signal with a 100 MHz signal for analyzing baseband (see page 93).

IR (Infrared Light)

The MPP can be used for detecting infrared signals with a 700 – 1100 nm wavelength.



To measure signals with the IR detector:

1. On the OSCOR unit, make sure that the “IR (Infrared Light)” input is selected.
2. The IR detector on the MPP is located on the end with the Photo Detector label. Point this end toward any suspected IR source.

Notes

- Infrared signals must be line of sight between the MPP and either the infrared transmitter or a reflection from the transmitter. For best results in locating transmitters, point the infrared receiver in all directions in a variety of angles (e.g., pointed up or pointed down) while sweeping a room.
- The 100 MHz Baseband Upconvert option mixes the signal with a 100 MHz signal for analyzing baseband (see page 93).

(Carrying strap is not an included accessory)

VL (Visible Light)

The MPP can be used for detecting visible light transmitters with a wavelength range of 450 – 1100 nm.

To measure signals with the VL (Visible Light) detector:

1. On the OSCOR unit, make sure that the "VL (Visible Light)" input is selected.

2. The Visible Light detector is located on the end of the MPP with the Photo Detector label. Point this end toward any suspected visible light transmitter.

Notes

- For best results in locating visible light transmitters, point the visible light receiver in all directions in a variety of angles (e.g., pointed up or pointed down) while sweeping a room.

- The 100 MHz Baseband Upconvert option mixes the signal with a 100 MHz signal for analyzing baseband (see page 93).

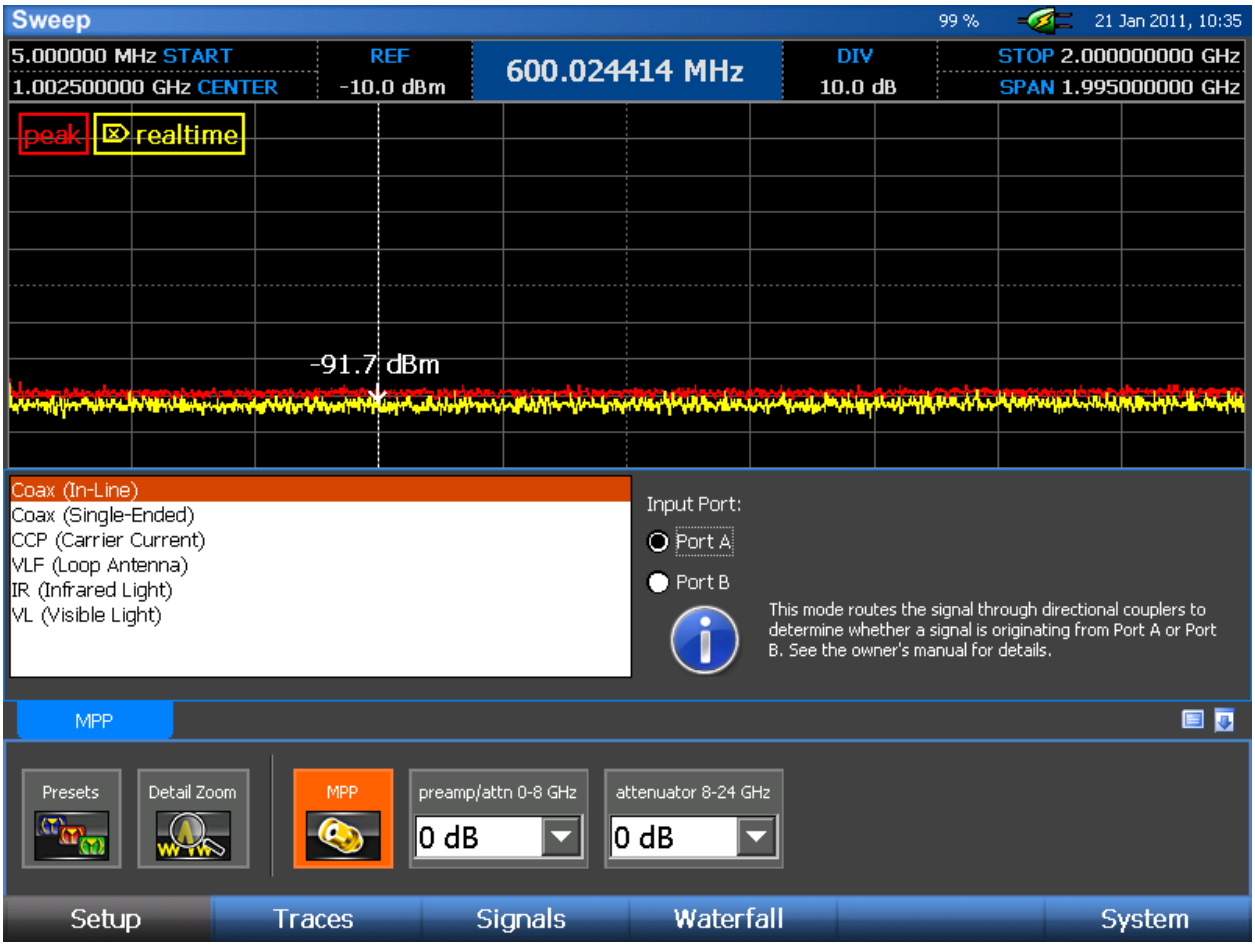
100 MHz Baseband Upconvert

The 100MHz Baseband Upconvert option is available for all of the MPP inputs except Coax (In-Line). This option mixes the selected input with a 100 MHz signal, which effectively shifts everything in the spectrum up 100MHz. When this option is enabled the span of the OSCOR unit is fixed from 100MHz to 120MHz. This can be very helpful in analyzing baseband signals. Because of the improved resolution bandwidth in Analyze Mode, it is better to evaluate baseband signals in Analyze Mode.

Disabling/Disconnecting the MPP

To leave the MPP physically connected to the OSCOR, but use the built-in antenna panel:

1. From the Main Menu select Setup or press **F1**.



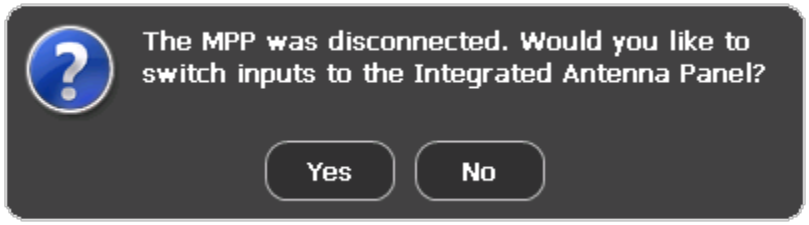
2. Deselect the *MPP* icon from the Setup Sub-Menu. The built-in antenna panel is now active.

3. To return to the MPP, select the *MPP* icon again from the Setup Sub-Menu, so that it is highlighted in orange.

To disconnect the MPP and return to the built-in antenna panel:

1. Disconnect the MPP from the AUX Jack and the 0-8 GHz auxiliary jack on the back of the OSCOR unit.

2. Upon disconnecting the MPP from the AUX jack, you will be presented with a dialog box.



3. Select *Yes* or press **F5** to close the MPP tab and return to the built-in antenna panel. Selecting *No* or pressing **F6** will close the MPP tab and leave the Aux RF input active.

SPECIFICATIONS

RF SYSTEM

Frequency: 8GHz Model= 10kHz to 8GHz, 24 GHz Model = 10kHz to 24GHz
Displayed Average Noise Level (DANL) (25kHz Resolution Band Width):
Without Preamp**=** -100dBm
With Preamp = -110 dBm
Sweep Speed: 24GHz/second
Preamp: DC–8 GHz = 10 dB
Attenuation: DC-24GHz = 0dB, -10dB, -20dB, -30dB
Dynamic Range: Min/Max Range: 90dB, SFDR: 80dB

AUDIO SYSTEM

Demodulation Types: AM, FM
Filters Sizes: 800 kHz, 200kHz, 12.5kHz, 6.25 kHz, 2kHz
Subcarrier Filters: 6.25 kHz, 12.5 kHz, 200 kHz
Headphone Output (low leakage headphones included)
Built-in Speakers

VIDEO SYSTEM

Formats: NTSC, PAL, SECAM
Demodulation: AM, FM
Filter Sizes: 12.75 MHz, 6.375 MHz
Subcarrier Filters: 6.25 kHz, 12.5 kHz, 200 kHz

ANTENNA SYSTEM

Built in Auto Switching Antenna System
Frequency: 8GHz Model = 100kHz to 8GHz, 24GHz Model = 100kHz to 24GHz
DA-8000 Directional Antenna:
Frequency: 1.5 GHz – 8 GHz

INPUTS/OUTPUTS

Aux RF In: 10kHz to 8GHz
IF Out: 75 MHz @ 25 MHz BW
Baseband Out: DC – 6MHz
Expansion: Aux Control Port for MPP

USER INTERFACE

Integrated Touch Screen with 8.4” Display
Soft Keys and Rotary Optical Encoder
USB Port (A type): for peripherals (Keyboard, Mouse)

POWER SUPPLY

Universal Power Supply included: 100-240VAC, 50-60Hz
Removable Battery: Rechargeable Lithium ion, 2-3 hour runtime

SPECIFICATIONS

EXTERNAL STORAGE CAPABILITY

Compact Flash (CF) Slot
USB-A Port

MECHANICAL

Dimensions: 11.5 in x 13.2 in x 3.0 in (29.2 cm x 33.5 cm x 7.6 cm)
Weight with Battery: 9.6lbs (4.4 kg)
Case Dimensions: 5.5 in x 14.9 in x 19.5 in (14 cm x 37.8cm x 49.5cm)
Loaded Case Weight: 21.0 lbs (9.5kg)
Operating Temperature: 0°C to +50°C

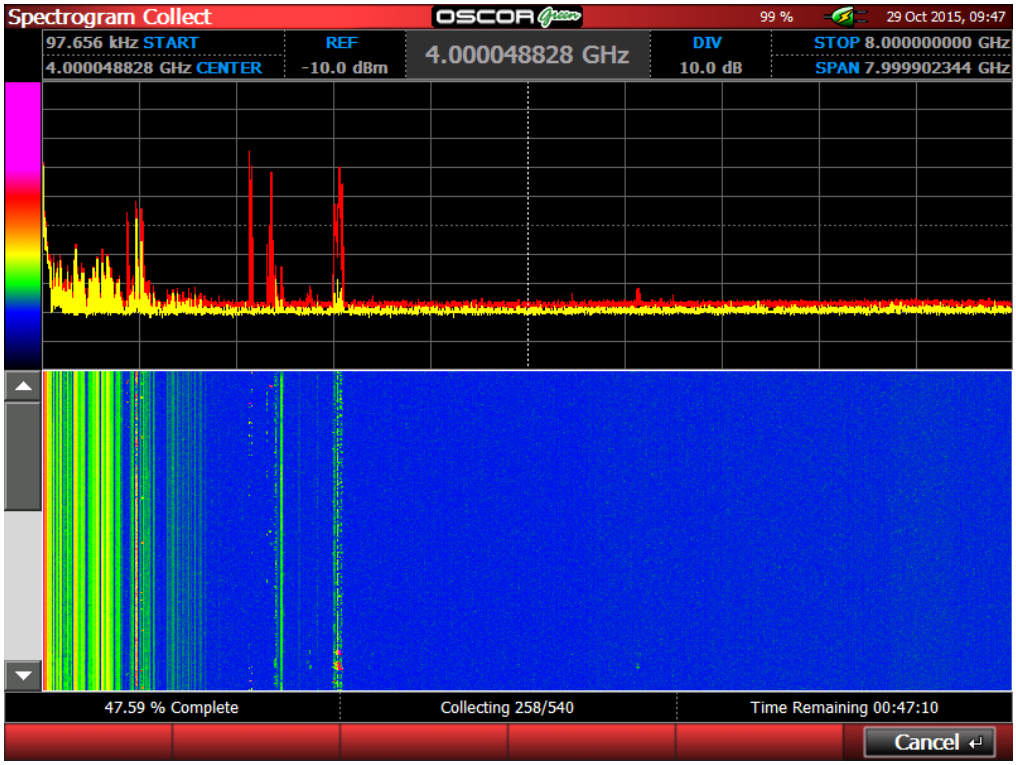
CE

Product specifications and descriptions subject to change without notice

APPENDIX

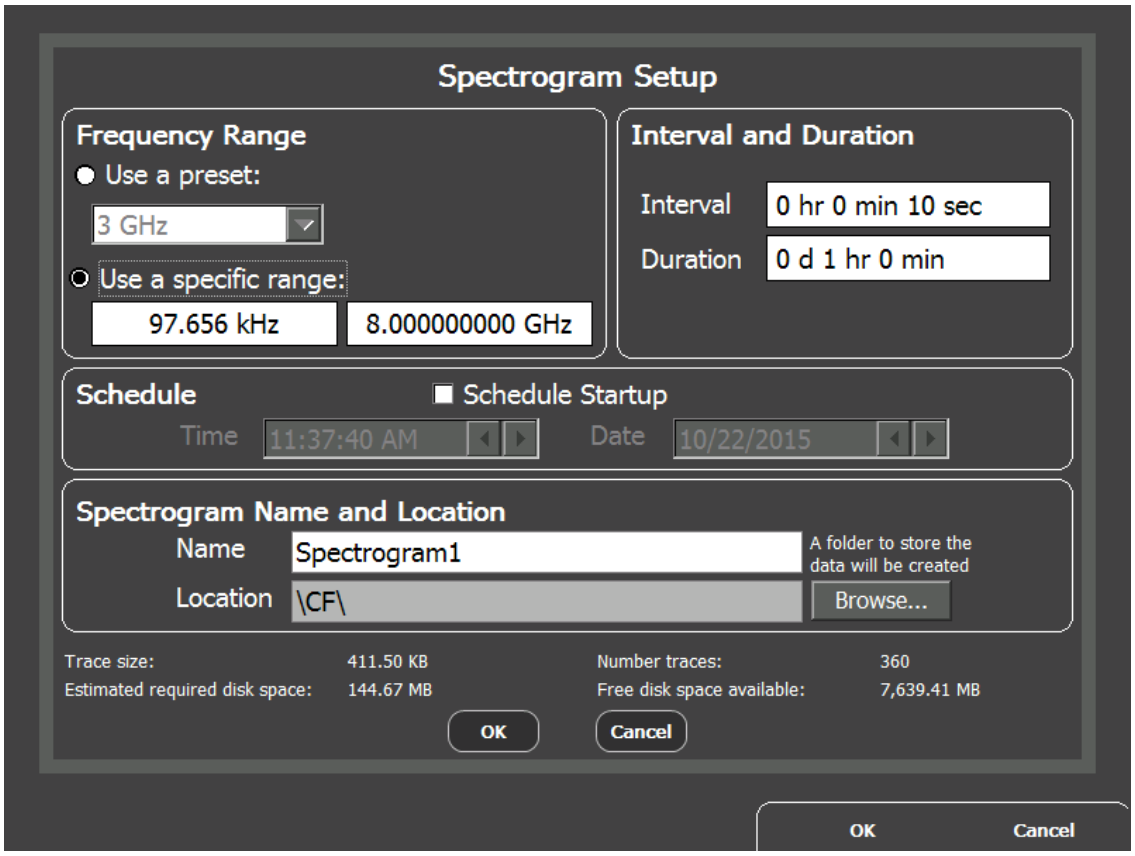
Spectrogram

The Spectrogram is designed to collect high resolution traces from the spectrum trace data over long periods of time. The Spectrogram allows for even more detailed analysis than the Live Raster Waterfall. Unlike the Live Raster Waterfall, which is stored as a bitmap image from the display, the Spectrogram is stored as raw binary trace data; all of the trace information is available for later analysis. During the Spectrogram collection process, all of the collected trace information, including a time stamp, is saved, so that each trace can be analyzed at a later time.



Collecting a Spectrogram

1. From the Main Menu, select *Waterfall* or press **F4**.
2. From the Waterfall Sub-Menu, select *Spectrogram* or press **F2**.
3. From the Spectrogram Sub-Menu, select the *Collect* icon.
4. In the dialog box that appears setup for the Spectrogram collection session.



a. Frequency Range – select from a preset or use a specific range by specifying a start frequency and a stop frequency.

b. Interval and Duration – select an interval and a total time for collecting. The minimum interval is 10 seconds.

   i. To adjust the interval or duration, each portion of the field (d, hr, min, sec) can be selected individually and adjusted using either the up and down arrow keys or the numeric keypad.

   ii. Because of the size of each trace that is stored, the Spectrogram can quickly consume a lot of storage space. As you adjust the interval and total time for your Spectrogram, the information at the bottom of the dialog box will display the number of traces that will be included in your collection session and how much disk space will be required. If you do not have enough free space available, the OSCOR unit will not let you begin the collection. Either increase the interval with which you are collecting or decrease the duration of your collection. Each trace collected is a peak interval, so no spikes in RF energy that occur between intervals will be missed. During the interval specified in the Spectrogram Setup, each peak that occurs is captured and will be displayed as part of the next collected trace.

c. Schedule - You can also schedule a start time for the Spectrogram collection session.

   i. To schedule the collection to start at a later time, select *Schedule Startup* with the stylus, then enter a start time & date. Each portion of the time (hr, min, sec) can be selected individually and adjusted using either the up or down arrow keys, the on-screen arrow buttons next to the *Time* field, or the numeric keypad. The Date field can be adjusted the same way.

   ii. If scheduling the collection to start at a later time, after hitting *OK* on the setup dialog box the OSCOR unit will switch to the Spectrogram Collect Screen and display the scheduled start time with a countdown. Press *Stand by* or **F5** to turn off the OSCOR unit. It will power back up and start collecting at the scheduled time. Press *Cancel* or press **F6** to cancel the session.

   iii. If you select *Stand by* mode in the step above and turn the unit back on before the scheduled start, the OSCOR unit will return to the Spectrogram Collect Screen with the countdown dialog box on screen. At that time you will have the option to either return to *Stand by* (**F5**) or *Cancel* (**F6**) the session.

d. Spectrogram Name and Location - select a location (either a USB flash drive or compact flash card) and type a file name for the stored Spectrogram file.

5. Select *OK* in the dialog box to begin collecting.

6. During the Spectrogram collection, no other operation can be performed. The status bar at the bottom of the screen will display information about the progress of the Spectrogram collection. This status information includes percent complete, the number of traces collected, and the time remaining.

7. To display the Spectrogram full screen while collecting traces, double tap on the spectrogram portion of the screen with the stylus. To return to the original screen configuration, double tap the Spectrogram with the stylus again.

Opening a Stored Spectrogram

1. If you are not already in the Waterfall | Spectrogram Sub-Menu, from the Main Menu select *Waterfall* | *Spectrogram*.

2. From the Spectrogram Sub-Menu, select the *Review* icon.

3. In the dialog box that appears, choose a previously stored Spectrogram and select *OK* or press **F5**. Note: The Spectrogram collection session creates a folder for the spectrogram data using the name you designated while setting up the session. Open this folder and select the .wfl file inside to open the Spectrogram for review.

4. The Spectrogram Review Screen will appear.

Reviewing Spectrograms

All traces collected during the Spectrogram session are stored in their entirety for review. After opening a Spectrogram, use the following tips to review the information:

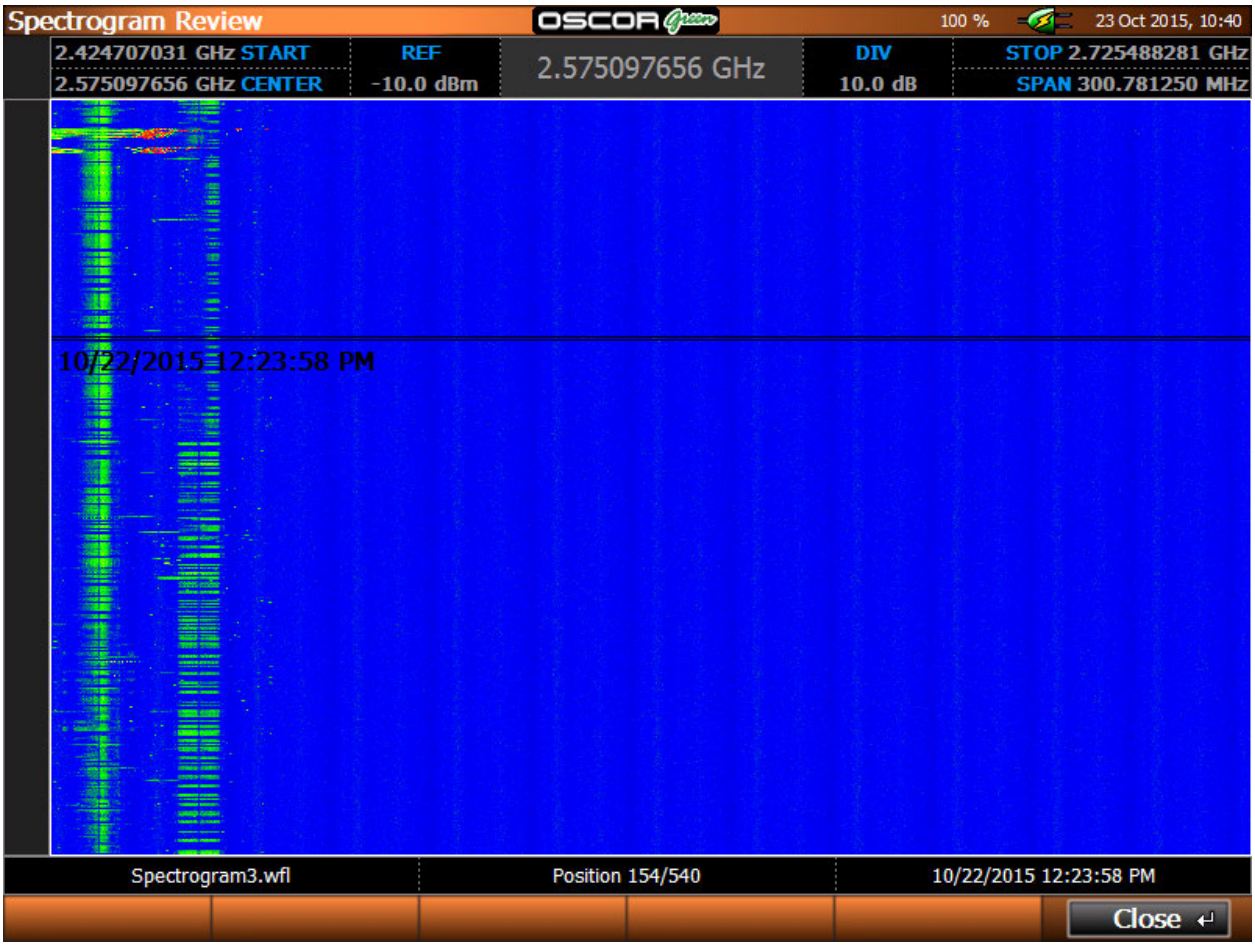
1. There are two cursors: a trace cursor and a Spectrogram cursor. The trace cursor is the vertical cursor in the spectral display. The trace cursor will tell you the frequency and dB level for any signals in the trace currently on screen. The Spectrogram cursor is the horizontal cursor in the Spectrogram display. This cursor moves up and down through the Spectrogram display and its position determines which trace is currently displayed in the spectral display. The Spectrogram cursor will also indicate a timestamp for the currently displayed trace. Only one of these cursors is active at a time. To make the trace cursor active, tap the spectral display with the stylus or your finger. Once the trace cursor is active, the rotary knob will move the cursor along the trace in the spectral display. To make the Spectrogram cursor active, tap the Spectrogram display with the stylus or your finger. Once the Spectrogram cursor is active, the rotary knob will move the cursor up and down the Spectrogram display. You can also use the **Tab** key to move back and forth between the trace cursor and Spectrogram cursor.

2. Depending on the number of traces collected, there may be more traces than can fit on a single screen. Pressing the **Down Arrow** key or the **Up Arrow** key will scroll the Spectrogram display to the next or previous screen. Use the timestamp information on the Spectrogram cursor or the information in the status bar below the Spectrogram display to help determine your position within the Spectrogram data. Pressing **Shift** + **Up Arrow** will take you to the top of the Spectrogram. Pressing **Shift** + **Down Arrow** will take you to the bottom of the Spectrogram.

3. Depending on how large of a frequency span you used, when you open a Spectrogram to review it, it may not initially show the entire span. To see more of the RF spectrum or to zoom in on a certain frequency, use the **Expand** and **Narrow** keys.

4. If your spectral display is not currently set to maximum span, touching the right side of the spectral display with the stylus or your finger and *dragging* to the left will pan the spectral display to higher frequencies. Touching the left side of the spectral display with the stylus or your finger and dragging to the right will pan the spectral display to lower frequencies. Pressing the **Right Arrow** key or the **Left Arrow** key will achieve the same effect.

5. To display the Spectrogram full screen during review, double tap on the Spectrogram portion of the screen with the stylus. To return to the original screen configuration, double tap the Spectrogram with the stylus again.



6. When you are finished reviewing the Spectrogram, select *Close* or press **F6** to return to Sweep Mode.

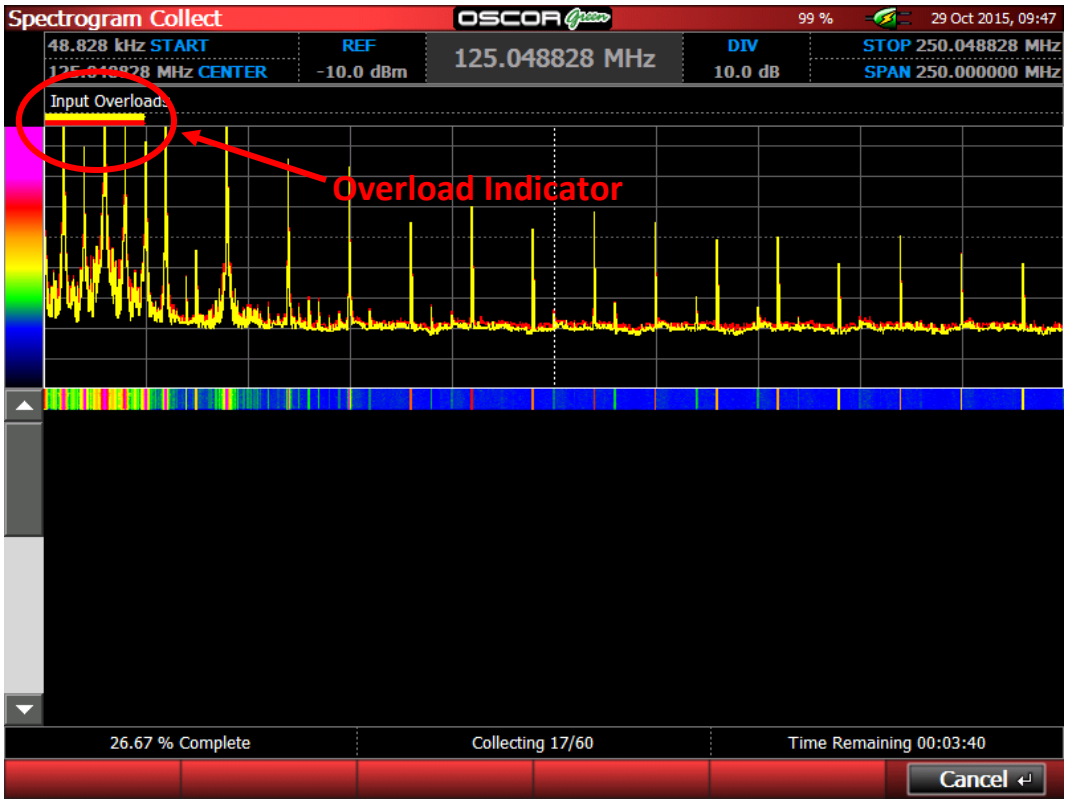
Modifying the Spectrogram Color Gradient

The Color Gradient for the Spectrogram can be customized just like the color gradient for the Live Raster Waterfall. See the Live Waterfall section for details on adjusting.

- The gradient can be customized while collecting traces, but changes will not take effect until after the session has completed.
- Any changes that are made during Review Mode will take place immediately.
- Color gradient information is not stored with the Spectrogram data. When opening previously collected Spectrograms, the Spectrogram is always displayed with the current color gradient applied.

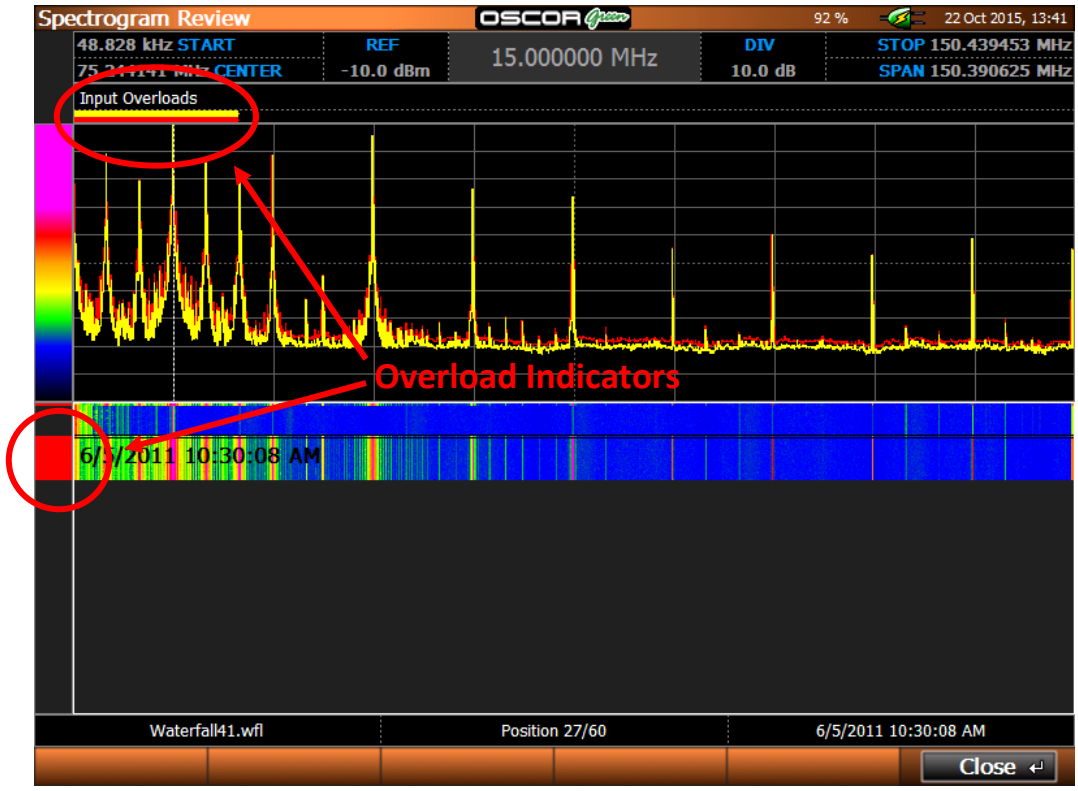
Receiver Overload – Spectrogram Mode

The screenshots below demonstrate the receiver overload indications for the Spectrogram while collecting traces and while in review mode. A receiver overload condition, which was described earlier, can be fixed by applying input attenuation. Apply the smallest amount of attenuation that prevents the overload condition. Begin by applying 10 dB of attenuation. If 10 dB of attenuation will not get rid of the overload indicators and any false spurs, then try 20 dB, and then 30 dB.



The screenshot above shows an overload condition occurring while collecting a Spectrogram. Just as in Sweep Mode and Live Raster Waterfall Mode, an overload condition is indicated by bars just above the frequency spectrum. The color of the overload bar will correspond to the display color of the trace which has the overload condition present.

If an overload condition is encountered while collecting a Spectrogram, stop the collection session by selecting *Cancel* or pressing **F6**. While monitoring the suspect signal in Sweep Mode, apply the smallest amount of input attenuation that prevents the overload condition, then start collecting the Spectrogram again.



The screenshot above shows a previously collected Spectrogram being reviewed. A very strong signal which was present while the Spectrogram was being collected caused an overload condition to occur. The red bar to the left of the Spectrogram displays indicates the traces which contain an overload condition. If the overload condition is encountered while reviewing a Spectrogram, any trace with the overload condition could contain false spurs. If it is possible to repeat the collection of the Spectrogram with input attenuation applied, then this should be done.

Exercise – Using the Spectrogram To Detect Intermittent Transmitters

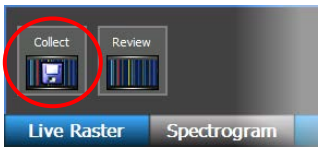
The Spectrogram allows for detailed trace capture and analysis. While collecting a Spectrogram, all of the collected trace information, including a timestamp, is saved, so that each trace can be analyzed at a later time. For this exercise, we will learn how to setup a Spectrogram collection and how to review it afterwards.

For this example, the collection was set for 24 hours. During those 24 hours, both a frequency hopping transmitter and a burst transmitter were turned on at separate times. You could simulate this in your exercise by turning a transmitting signal on/off, such as a cell phone or a baby monitor, during the Spectrogram collection.

Press the **Power** button to turn the unit on.

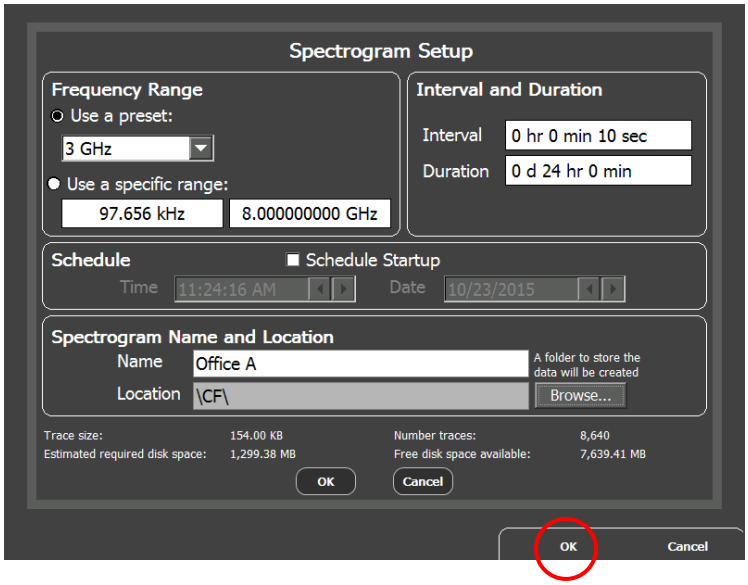
Press **F4** or select *Waterfall* from the main menu.

Press **F2** or select *Spectrogram* from the Waterfall sub-menu.



Select the *Collect* icon from the Spectrogram Sub-menu.

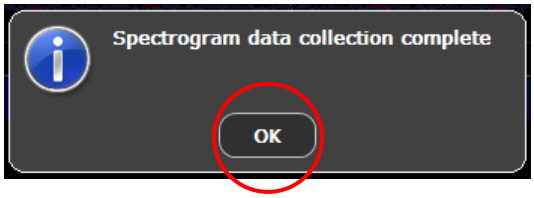
A dialog box will appear, allowing you to adjust the settings for the Spectrogram collection. The illustration to the right shows the settings that were used for this exercise.

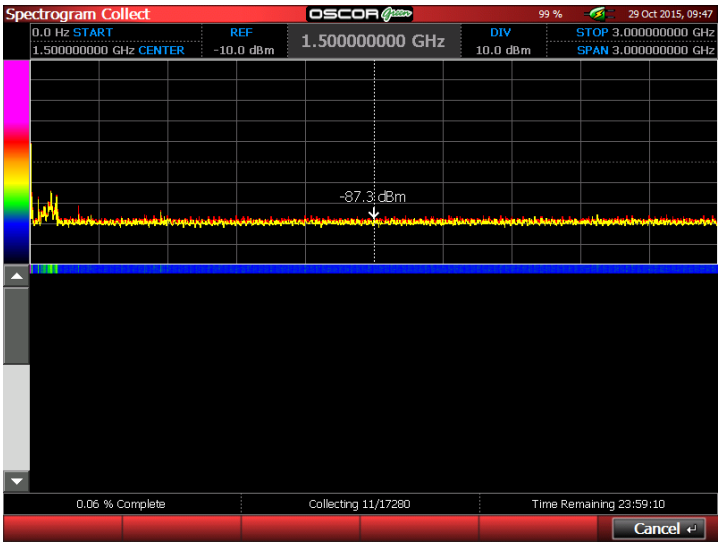


It is important to note that the memory required to store your Spectrogram will vary depending on the frequency range, trace interval, and total time settings. The estimated required disk space is displayed at the bottom of the dialog box. The OSCOR will not allow the collection to start if this exceeds the free space available on the USB drive or CF card that is inserted.

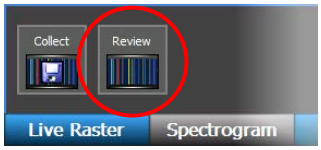
Press *OK*.

The OSCOR will begin collecting trace data. During the collection, the top half of the screen will display a peak trace and the most recently captured trace. The bottom half of the screen will display the trace data in a waterfall format. When the collection has finished, a dialog box will appear to alert you. Press *OK*.

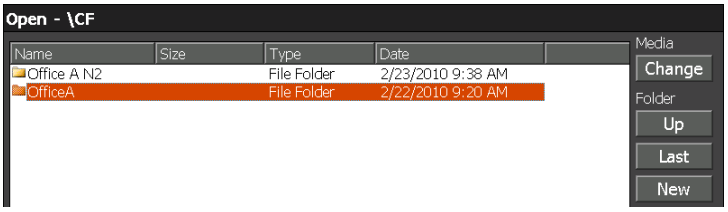




Note: During the collection process, only the most recent traces are stored in a buffer and displayed (approximately 600 traces). However, all captured traces will be saved to your selected media and will be available for review after the collection is finished.



The Spectrogram Sub-Menu will still be visible. Select the *Review* icon.

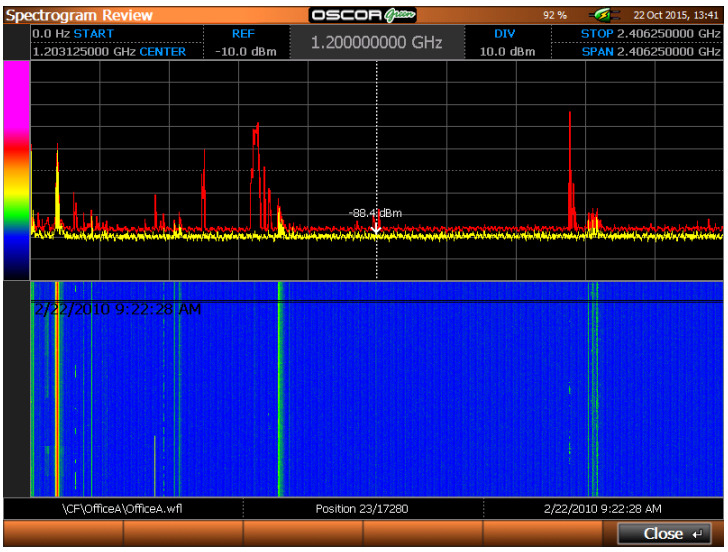


A dialog box will open up. Make sure that the media to which you saved the Spectrogram is still inserted in the OSCOR unit and the contents are displayed in the dialog box. If necessary, switch to your media by selecting the *Change* button under 'Media' on the right side of the dialog box.

There will be a folder for each Spectrogram that you have collected. Double-click on the folder for the Spectrogram that you want to review.

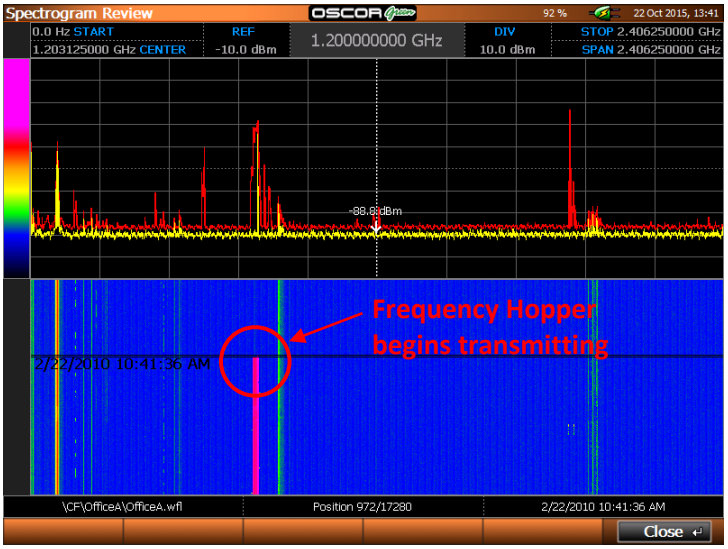
Once the contents of that folder are displayed, click on the .wfl file and select *OK*.

After loading, your Spectrogram data will be displayed. The top half of the screen will display individual traces. The bottom half of the screen will display multiple traces in a waterfall format.



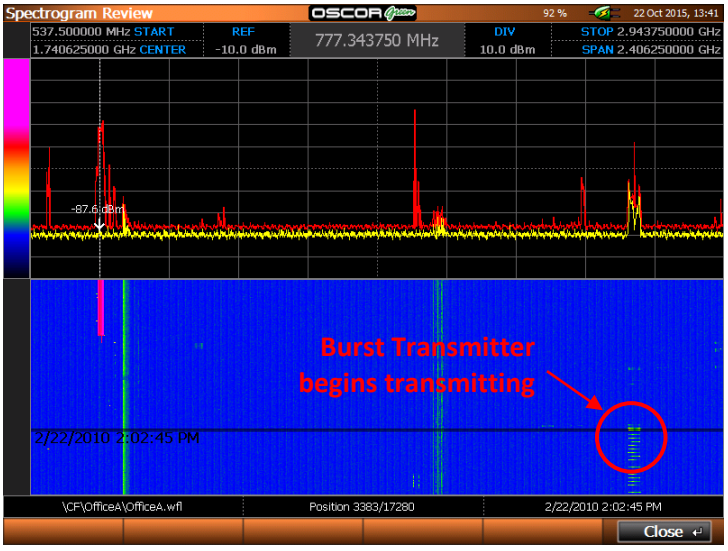
Tap the bottom half of the screen with the stylus and turn the rotary knob. This will change the position of the Spectrogram cursor. Notice as you move the cursor through the Spectrogram data, the timestamp will change to indicate the time the currently selected trace was captured. Also, the top half of the screen will change to display the currently selected trace and peak.

You can scroll through the Spectrogram data by clicking and dragging with the stylus or by pressing the arrow keys. You can also zoom in and out on the Spectrogram data by pressing the **Narrow** and **Expand** buttons.



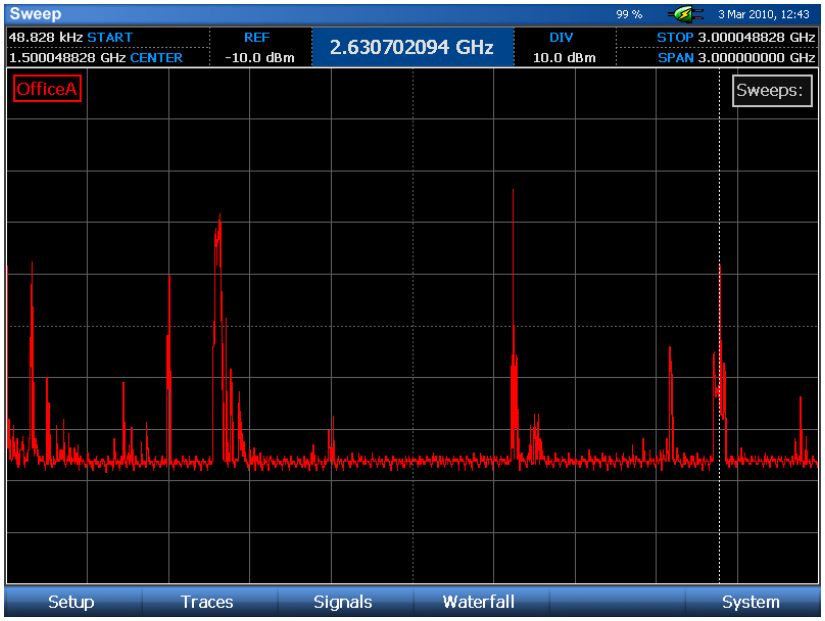
By scrolling through the Spectrogram data using the arrow keys, it is easy to see intermittent transmitters that may have begun transmitting while collecting. The pictures to the right indicate where the frequency hopper and the burst transmitter began transmitting.

By using the timestamp on the Spectrogram cursor, we can determine the approximate times that transmission began. From the timestamp shown in the pictures on the right, we can determine that the frequency hopper began transmitting on 2/22/10 around 10:41am. The burst transmitter began transmitting on 2/22/10 around 2:02pm.



As you move the Spectrogram cursor through the data, pay attention to the displayed traces on the top half of the screen. The red trace is a peak trace of the complete Spectrogram collection session. The yellow trace displays the signals that were present at the time of the timestamp on the Spectrogram cursor.

Compare the data in the Spectrogram to a peak trace taken during the same period as the Spectrogram recording.



With the peak trace it is also easy to see the frequency hopper at approximately 778 MHz and the burst transmitter at 2.6 GHz, however, we cannot determine any information such as when the transmissions started, how long the transmission continued, nor can we tell that these were frequency hopping and burst signals. We just know that a peak occurred at these frequencies. With the Spectrogram we are able to capture many more details to help with investigating these suspect signals.

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